Vital Signs Menu

Old Style VSM Service Manual 95P360E

For a service manual covering the older VSMs, click on the "Old Style Service Manual 95P360E" button above.

Welch Allyn

This manual covers the Enhanced Vital Signs Monitor introduced in June 1999. The Enchanced VSM is easily detected by a dark blue "Silence" button on the front panel instead of a grey button.

Service Manual

Vital Signs Monitor

(52000 Series)

Protocol QuikSigns

(52000 Series)

Welch Allyn, Inc.
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95P445E Rev. C

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Revision History

Date	ECN#	Revision	Description	Originator	Approval
06/10/1999		A	Introduction of Service Manual	JDB	JDB
10/06/03	5-46657	B	Correction made to temperature accuracy, part numbers, error codes and updates to the drawings. Revised to meet Service Manual Work Instructions.	JDB, DLK	DLK
12/12/03	5-46990	C	Revised service and support details in Section 1 and Appendix E. Re-formatted units of measurement to meet NIST Standards. Corrected grammar and punctuation. Added page numbering to blank pages.	DLK	RJS

Drawings and/or illustrations and/or part numbers in this document are for reference only. For the most current revision call the Welch Allyn Customer Service phone number listed in Section 1.

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To Service Personnel

Read and understand the Vital Signs Monitor Operator's Manual and this service manual. The information contained in these publications are subject to change without notice and should not be construed as a commitment by Welch Allyn, Inc.

Welch Allyn assumes no responsibility for any errors that may appear in this manual. If the product and/or its operation varies significantly from any description herein, please contact the following:

Welch Allyn, Inc.
1-800-535-6663
315-685-4100
Fax (315)-685-3361

Welch Allyn, Inc.
4341 State Street Road
Skaneateles Falls, NY 13153

This product has been designed to provide a high degree of safety and reliability. However, we can not guarantee against: deterioration of components due to aging, normal wear, tampering, and abuse.

Only Authorized Welch Allyn personnel or agents must perform all service and repairs, using approved Welch Allyn replacement parts and approved process materials. Failure to follow these guidelines will invalidate the product warranty. Please refer to the product warranty for specific coverage.

Intent of Manual and Product Scope

This manual provides technical service and re-calibration information to technicians authorized to repair and re calibrate Welch Allyn, Inc. products. When used in conjunction with the required test equipment and tools, technicians will be able to diagnose, repair, and re-calibrate, and test the Vital Signs Monitor.

The manual includes: Re-calibration instructions, fault/cause analysis, step-by-step disassembly and re-assembly procedures, repair, adjustment, and re-test procedures.

Limited Warranty

Welch Allyn, Inc. warrants the Vital Signs Monitor, when new, to be free of defects in material and workmanship and to perform in accordance with manufacturer's specifications for a period of two years from the date of purchase from Welch Allyn, Inc. or its authorized distributors or agents. Accessories (battery, cuff, tubing, temperature probe, SpO_2 sensor and transformer) carry a one-year warranty. Welch Allyn, Inc. will either repair or replace any components found to be defective or at variance from manufacturer's specifications within this time at no cost to the customer. It shall be the purchaser's responsibility to return the instrument to Welch Allyn, Inc. or an authorized distributor, agent or service representative. This warranty does not include breakage or failure due to tampering, misuse, neglect, accidents, modification or shipping. This warranty is also void if the instrument is not used in accordance with manufacturer's recommendations or if repaired by other than Welch Allyn, Inc. or an authorized agent. Purchase date determines warranty requirements. No other express warranty is given.

To receive service assistance or to ask questions regarding this warranty, please call your nearest Welch Allyn Technical Support Center.

Owner Maintenance

Owner Maintenance: Non-Technical customers can perform normal maintenance per the instructions provided in the Operator's Manual. End users will be able to perform basic operations such as replacement of: hoses, cuffs, probes, and batteries. On this level the unit will not be opened (except for the battery housing). Opening of the Vital Signs Monitor by untrained individuals will damage the unit and void the warranty.

Warranty, Service, and Spare Parts

Warranty Service
All repairs on products under warranty must be performed or approved by Welch Allyn. Unauthorized repairs will void the warranty. In addition, whether or not covered under warranty, any product repair shall exclusively be performed by Welch Allyn trained and certified service personnel.

Assistance and Parts
If the product fails to function properly or if assistance, service, or spare parts are required, contact the nearest Welch Allyn Technical Support Center.

USA 1-800-535-6663

Latin America (+1) 305-669-9591

European Call Center (+353) 469-067-790

United Kingdom 0-207-365-6780

France (+33) 1-60-09-33-66

Germany (+49) 7477-927-173

Canada 1-800-561-8797

South Africa (+27) 11-777-7509

Australia (+61) 2-9638-3000 Singapore (+65) 6291-0882

Japan (+81) 3-5212-7391 China (+86) 21-6327-9631

Before contacting Welch Allyn it is helpful to attempt to duplicate the problem and to check all accessories to ensure that they are not the cause of the problem.

When calling, please be prepared to provide:
- The product name, model number and complete description of the problem
- The serial number of your product (if applicable)
- The complete name, address and phone number of your facility
- For out-of-warranty repairs or spare parts orders, a purchase order (or credit card) number
- The required spare or replacement part number(s), for parts order

Repairs
If your product requires warranty, extended warranty, or non-warranty repair service, please call first the nearest Welch Allyn Technical Support Center. A representative will assist you in troubleshooting the problem and will make every effort to solve the problem over the phone, avoiding potential unnecessary return.

In case the return cannot be avoided, the representative will record all necessary information and will provide a Return Material Authorization (RMA) number, as well as the appropriate return address.

A Return Material Authorization (RMA) number must be obtained prior to any return. Be sure to note this number on the outside of your shipping box.

Packing Instructions
- If you have to return goods for service, follow these recommended packing instructions:
- Remove all hoses, cables, sensors, power cords, and ancillary products (as appropriate) before packing, unless you suspect they are associated with the problem.
- Wherever possible use the original shipping carton and packing materials.
- Include a packing list and the Welch Allyn Return Material Authorization (RMA) number.
- Be sure to note the (RMA) number on the outside of your shipping box.

It is recommended that all returned goods be insured. Claims for loss or damage to the product must be initiated by the sender.

Periodic Calibration Requirements

Welch Allyn, Inc. recommends that the calibration of the Vital Signs Monitor be checked on a yearly basis for BP, Temperature and SpO_2 (if applicable).

Incoming Inspection

NOTE: *Use the following guidelines when unpacking the Vital Signs Monitor from its shipping carton.*

1. Before opening the Vital Signs Monitor shipping carton, check for damage.

2. If damage is apparent, stop unpacking the carton and contact the shipping company for further instructions. If the carton is intact, unpack the Vital Signs Monitor.

3. With the Vital Signs Monitor out of its carton, check to see that all the items listed on the packing slip are included.

4. If an item is missing, first check the carton, then check with your receiving department. If necessary contact your nearest Welch Allyn representative.

5. Clean and disinfect by following the instructions printed in the Operator's Manual.

Note: *Perform all functional tests as listed in Section 3 before and after servicing. Operate the Vital Signs Monitor to verify the customer complaint before making any changes to the unit. Call the customer if the complaint is unclear.*

If the unit has caused or is suspected of having caused an injury of any type: **DO NOT DISASSEMBLE OR REPAIR THE UNIT IN ANY WAY.** Contact your nearest Welch Allyn Customer Support Center immediately.

Introduction

The Welch Allyn Vital Signs Monitor, also marketed as QuickSigns, is designed to non-invasively and automatically measure systolic and diastolic pressure, pulse rate, temperature and oxygen saturation (SpO_2) for adult and pediatric patients. **THE WELCH ALLYN VITAL SIGNS MONITOR IS NOT TO BE USED ON NEONATAL PATIENTS.** All blood pressure, pulse, temperature and SpO_2 values can be viewed on a large, easy-to-read display, and may be printed via the integrated printer as desired.

The rechargeable lead acid battery and variety of mounting accessories make the Welch Allyn Vital Signs Monitor convenient for many locations. The operator may choose any combination of simultaneous measurement modalities. This flexibility, combined with features such as programmable alarms and automatic BP cycles, makes the Welch Allyn Vital Signs Monitor ideal for a wide variety of patient monitoring needs.

Refer to the Welch Allyn Vital Signs Monitor Operator's Manual for complete information on Indications For Use, Special Features, Supplies and Accessories.

Basic System Operation

Blood Pressure Operating Modes

When a blood pressure measurement cycle is initiated, the cuff will automatically inflate to the default pressure level.

The cuff will immediately begin to deflate in a stepped fashion and will determine systolic pressure and diastolic pressure from the pulses sensed by the cuff at various pressure levels. This is the oscillometric method of non-invasive blood pressure monitoring.

Blood pressure measurements may be initiated manually, or automatically at time intervals determined by the user.

At the completion of a measurement cycle the systolic and diastolic pressures are displayed. If the Monitor is in Automatic Mode, the measured values are kept on display until the next BP measurement is initiated. When not in Automatic Mode, the measured values are displayed for two minutes, after which time the display screen is blanked. The most recent BP measurement may be recalled by pressing the **REVIEW** button.

When in Automatic Mode, if the unit is unable to determine the systolic or diastolic value, the measurement will be automatically repeated once.

Blood Pressure Manual Mode

In the Manual Mode, a single blood pressure determination is made only when the **START** button is pushed. The manual mode is the default mode of operation for blood pressure determinations.

A measurement cycle may be cancelled at any time by pressing the **CANCEL** button. This action immediately initiates a rapid cuff deflation.

The blood pressure measurement data will appear on the display immediately following the measurement. The display will blank after two minutes. If the display is blank, pressing the **REVIEW** button on the front panel will recall the measurement. Up to 99 prior measurements are available for review or printing.

In Blood Pressure Manual Mode, the following alarm limits may be activated; SYSTOLIC HIGH LIMIT, SYSTOLIC LOW LIMIT, DIASTOLIC HIGH LIMIT, DIASTOLIC LOW LIMIT, PULSE RATE HIGH LIMIT and PULSE RATE LOW LIMIT. Blood pressure determinations, which activate alarms, are indicated by flashing displays and a repetitive audible tone. If an alarm limit is violated, subsequent blood pressure determinations may be made only after the alarm condition is reset by pressing any button on the Monitor's display.

Blood Pressure Automatic Mode

The Automatic Blood Pressure Mode is entered by pressing the **AUTO** button. Pressing the **AUTO** button displays a choice of 11 cycle interval times as follows: "St" (STAT mode), 1 minute, 3 minutes, 4 minutes, 5 minutes, 10 minutes, 15 minutes, 30 minutes, 45 minutes, 60 minutes and 90 minutes. These choices represent the time interval from the beginning of one cycle to the beginning of the next automatic cycle. STAT mode allows the monitor to take continuous blood pressure measurements for 15 minutes. In addition, the operator may choose to disable the Auto Mode by choosing "--" (two dashes).

Note: *In the 1-minute automatic cycle mode, the Welch Allyn Vital Signs Monitor will automatically take blood pressure measurements in 1-minute intervals for up to 15 minutes.*

A measurement cycle may be cancelled at any time by pressing the **CANCEL** button. This action immediately initiates a rapid cuff deflation.

The blood pressure measurement data will appear on the display immediately following the measurement and will remain displayed until the next measurement cycle is initiated. In Blood Pressure Auto Mode, the following alarm limits may be activated; **SYSTOLIC HIGH LIMIT, SYSTOLIC LOW LIMIT, DIASTOLIC HIGH LIMIT, DIASTOLIC LOW LIMIT, PULSE RATE HIGH LIMIT and PULSE RATE LOW LIMIT**. Blood pressure determinations, which activate alarms, are indicated by flashing displays and a repetitive audible tone. Any alarm limit violation must be reset to continue automatically timed blood pressure determinations. The alarm may be reset by pressing any button on the Monitor's display.

Temperature Operating Modes

Thermometry measurements are made with the integrated Welch Allyn SureTemp™ thermometer. Oral and rectal probes utilize single-use disposable probe covers which limit cross-contamination. Oral, axillary or rectal temperatures are taken using **Normal** or **Monitor** operating modes. Axillary temperatures are taken using the oral probe.

In **Normal** mode the thermometer's microprocessor "predicts" body temperature in about 4 seconds for oral temperatures, about 10 seconds for axillary temperatures and in about 15 seconds for rectal temperatures. The **Monitor** mode displays the patient's actual temperature after 3 minutes for oral/rectal mode and 5 minutes for axillary mode, and will continue to display an updated temperature as long as the probe remains in place.

Note: *Normal mode axillary temperatures (10 seconds) are accurate only for children under the age of four.*
Note: *The Welch Allyn Vital Signs Monitor is not intended to be used on Neonatal patients.*

Temperature readings may be displayed in Fahrenheit or Celsius scales.

Temperature Normal Mode
In **Normal** mode, the device will measure temperature at discrete intervals and then calculate the rate of change according to a proven algorithm. This allows the thermometer to predict the end point that the thermistor would reach if it were left in the mouth until it reached mouth temperature. This predictive feature allows the thermometer to arrive at an accurate oral temperature reading in approximately 4 seconds.

Normal mode is the default operating mode for temperature determinations.

Operator selectable patient alarm limits are not available in temperature **Normal** mode. However, temperatures which are outside of the operating range of the device will be noted on the temperature display.

Temperature Monitor Mode
Continuous **Monitor** mode operation is normally used for longer term monitoring and when difficult situations prevent accurate temperatures from being taken in the Normal mode. The probe must be in contact with tissue for at least three (3) minutes for accurate oral/rectal temperature measurement and five (5) minutes for accurate axillary temperature measurement. **Monitor** mode temperatures may not be identical to predicted 'Normal' temperatures because of ambient temperature influence and other factors. The trend in temperature is the important standard to be observed when in the Monitor mode.

Operator selectable patient alarm limits are not available in temperature **Monitor** mode. However, temperatures which are outside of the normal operating range of the device will be noted on the temperature display.

SpO_2 Operating Mode
The Welch Allyn Vital Signs Monitor incorporates the Nellcor Puritan Bennett™ pulse oximetry module which determines arterial oxyhemoglobin saturation (SpO_2%) by measuring the absorption of red and infrared light passed through the tissues. Changes in absorption caused by pulsation of blood in the vascular bed are used to determine arterial saturation and pulse rate.

Oxygen saturation percent is calculated with each pulse detected, and thus the monitor display is continually updated. The pulse signal bar graph is an indicator of the strength and quality of the detected pulses.

When SpO_2 is measured, the patient's pulse rate is also measured and displayed. A pulse rate measurement from the SpO_2 determination overrides a pulse rate measurement derived from a blood pressure measurement.

When measuring SpO_2 the user may enable the SpO_2 Pulse Tone feature. A short audible tone is emitted with every patient heartbeat. The frequency of the tone is based on the patient's SpO_2 level. The lower the frequency of the tone, the lower the patients SpO_2 level.

In SpO_2 monitoring mode, operator selectable alarm limits for low SpO_2% may be activated. A condition which violates the SpO_2 low limit alarm is indicated by a flashing display and repetitive audible tone. Should a patient alarm condition for SpO_2 or pulse rate occur, the Monitor will indicate an alarm condition (flashing & beeping) while continuing to monitor and display the patient's current SpO_2%. The alarm will automatically reset when the patient's condition returns to within the preset alarm parameters.

Should a patient alarm condition for SpO_2 or pulse rate occur, the operator may invoke "Silence Mode" by pressing the **SILENCE** button. This will silence the audible tone (display will continue to flash), while the practitioner attends to the patient and the monitor. Silence mode resets automatically after 30 seconds, or when the patient's condition returns to within the preset alarm parameters.

Removal of the SpO_2 sensor from the patient will initiate an alarm, unless the SpO_2 and pulse rate alarms are turned off. To reset the sensor alarm, press any button on the Monitor's display.

SpO_2 is generally measured via pulses detected using a finger sensor. However, for certain situations SpO_2 may be measured at alternate sites including the earlobe, forehead and toes. Special sensors must be employed in these situations.

SpO_2 Monitor Mode

The SpO_2 monitor performs most accurately with the fingerclip sensor, which may be used on all fingers except the thumb. The finger clip sensor is recommended for spot checks or short term continuous monitoring.

The device determines arterial oxyhemoglobin saturation (SpO_2%) by measuring the absorption of red and infrared light passed through the tissue. Oxygen saturation and pulse rate are displayed on the LED digital display. On each detected pulse, the pulse signal bar graph flashes. The intensity of this signal is a simple visual indicator of waveform signal strength, and can identify situations where the pulsatile nature of the tissue may not be adequate for an accurate SpO_2 reading. The update interval of the bar graph should correspond to the patient's pulse rate. This is an indication of the quality of the SpO_2 signal.

All Welch Allyn Vital Signs Monitors with pulse oximetry capability are equipped with a pulse tone. This audible tone beeps in synchronization with each beat of the patient's heart. In addition, the frequency of the tone will vary based on the patient's oxygen saturation value. The higher the tone's frequency, the higher the patient's oxygen saturation value. The user may change the pulse tone volume, or turn this feature off as necessary.

Pulse Rate Feature
The Welch Allyn Vital Signs Monitor is capable of determining pulse rate as an adjunct to the blood pressure measurement and the SpO_2 measurement.

The pulse rate, in beats per minute, will be determined primarily from the SpO_2 measurement methodology. In the case where SpO_2 is not available, or is disabled, the pulse rate display will be driven by data from the blood pressure measurement method.

There are two operator selectable alarm limits for the pulse rate. They are **PULSE RATE HIGH LIMIT and PULSE RATE LOW LIMIT**. Pulse rates which activate alarm limits are indicated by a flashing display and a repetitive audible tone.

Should a pulse rate alarm occur when the pulse rate measurement is derived from the blood pressure measurement, no subsequent blood pressure or pulse rate measurements may be made until the alarm is reset. The alarm may be reset by pressing any button on the Monitor's display. Should a pulse rate alarm occur when the pulse rate measurement is derived from the SpO_2 measurement, the monitor will indicate an alarm condition (flashing & beeping) while continuing to monitor and display the patient's current SpO_2% and pulse rate. The alarm will automatically reset when the patient's condition returns to within the preset alarm parameters.

Should a patient alarm condition for pulse rate occur during SpO_2 monitoring, the operator may invoke "Silence Mode" by pressing the **SILENCE** button. This will silence the audible tone (display will continue to flash), while the practitioner attends to the patient and Monitor. Silence mode resets automatically after 30 seconds, or when the patient's condition returns to within the preset alarm parameters. If an alarm limit is violated, subsequent determinations of any type may only be made after the alarm condition is reset.

*NOTE: See **Nurse Call Interface** in the Operator's Manual for complete information on the Nurse Call interface.*

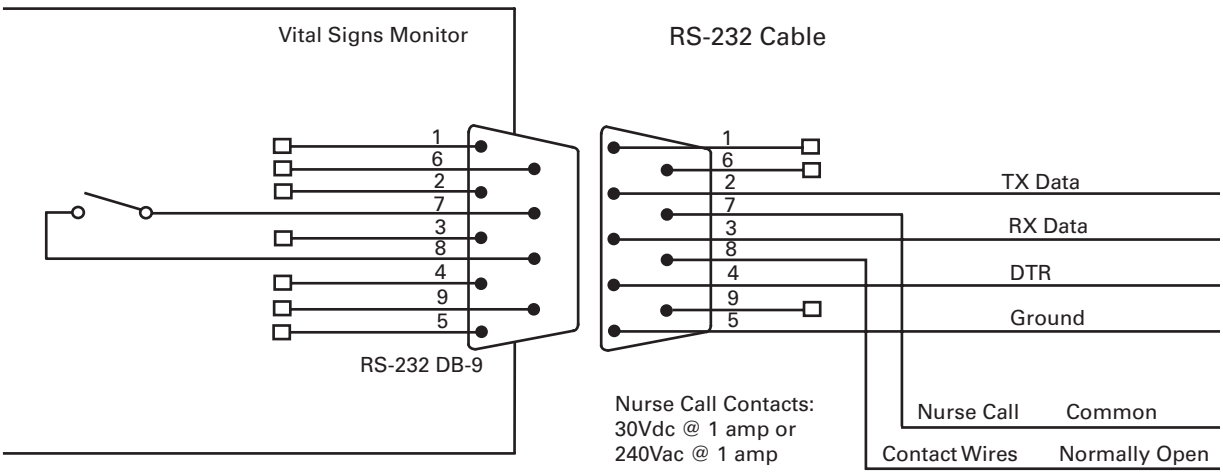


Figure 1-1. Nurse call interface diagram.

The Welch Allyn Vital Signs Monitor provides a switch closure output between two pins of the serial connector (pins 7 and 8). The output is universal in that it is compatible with a wide variety of different systems with no polarity dependence. The Nurse Call output is ohmically isolated from all circuitry.

The output is rated for 1 Amp at 240VAC or 30Vdc. During an alarm condition the output is closed, otherwise the output is open. During a power off or power failure condition the output is open.

Specifications

The performance specifications of the Vital Signs Monitor are as follows:

Patient Population
The Welch Allyn Vital Signs Monitor is designed for use with adult and pediatric patients. Welch Allyn defines a pediatric patient as 29 days old and above. **THE VITAL SIGNS MONITOR IS NOT INTENDED FOR USE WITH NEONATES.** Welch Allyn defines neonates as children 28 days or less of age born at term (37 weeks gestation or more): otherwise, up to 44 gestational weeks.

Cuff Pressure Range
0 mmHg - 300 mmHg

Initial Cuff Inflation
120, 140, 160, 180, 200, 240, 280 mmHg depending on pressure preset level. Pressure preset default is 160 mmHg.

Systolic Range
Maximum: 250 mmHg
Minimum: 60 mmHg

Diastolic Range
Maximum: 160 mmHg
Minimum: 30 mmHg

Blood Pressure Accuracy
Blood pressure accuracy meets or exceeds SP10-1992 AAMI standards for non-invasive blood pressure accuracy (AAMI standard: ±5 mmHg mean error; 8 mmHg standard deviation). Blood pressure accuracy is validated for pressure measurement using the upper arm only, with the patient in a seated position. Blood pressure is validated against manual auscultatory readings for adults and children above the age of 3. For children under age 3 blood pressures is validated against intraarterial readings. The monitor is not validated for use with neonates.

Blood Pressure Determination Time
20 seconds to 45 seconds typical, 165 seconds maximum.

Pulse Rate Range (Using SpO_2 determination)
Maximum: 200bpm
Minimum: 40bpm

Pulse Rate Accuracy
SpO_2 Module Heart Rate (Nellcor Puritan Bennett)±3 bpm
Blood Pressure Algorithm Heart Rate ±5.0%
Overpressure Cutoff
295 mmHg to 330 mmHg

Temperature Ranges
Maximum – 108 °F (42.2 °C)
Minimum – 84.0 °F (28.9 °C)

Temperature Accuracy
Calibration Accuracy: ±0.2 °F (±0.1 °C)

Temperature Determination Time
(Oral) 4 seconds typical, 15 seconds maximum
(Axillary) 10 seconds typical
(Rectal) 15 seconds typical

Oxygen Saturation Range (SpO_2%)
40-99% oxygen saturation

SpO_2 Accuracy
Nellcor MP205
±3% in the range of 70-100% oxygen saturation (1 Standard Deviation)
<70% unspecified by the OEM.

Nellcor MP506
Without Motion - Adults: 70 to 100% ± 2 digits*
With Motion - Adults: 70 to 100% ± 3 digits**
Low Perfusion: 70 to 100% ± 2 digits***
<70% unspecified by the OEM
Bio compatibility testing has been conducted on Nellcor sensors in compliance with ISO10993-1, Biological Evaluation of Medical Devices, Part 1: Evaluation and Testing. The sensors have passed the recommended bio compatibility testing and are therefore in compliance with ISO 10993-1.

* Adult specifications are shown for OxiMax MAX-A sensors. Saturation accuracy will vary by sensor type. Refer to the following Sensor Accuracy Grid.
**Applicability: OxiMax MAX-A, MAX-P, and MAX-I sensors.
*** Specification applies to monitor performance and was validated with Biotek and Nellcor simulators.

Battery Charging (90%-100% capacity in 12 hours).
Unit will operate and charge battery simultaneously when connected to power source.

Mechanical Specifications

Dimensions
Height 6.5 inches (16.5 cm)
Length 8.6 inches (21.8 cm)
Depth 5.0 inches (12.7 cm)

Weight
Approximately 6 pounds (2.8 Kg)

Mounting
Self-supporting on rubber feet
Custom Mobile Stand
Custom Made Wall Mount
Custom IV pole mount
Attaches to bed rail

Electrical Specifications

Power Requirements
Patient-Rated isolation transformer is connected to AC mains:
North American Version: 120 Vac, 60 Hz 0.20 A Input Source, 8 Vdc, 0.75 A Output Source
International Version: 220-240 Vdc, 50-60 Hz 0.20A Input Source, 8 Vdc, 0.75 A Output Source
Battery (Lead acid, with external charger)
A fully charged battery will support **200**"typical" blood pressure determinations taken at 7 minute intervals. Battery is 90%-100% charged after 6-12 hours of charging. The battery automatically charges when the Vital Signs monitor is powered through the AC power transformer. The battery will charge faster when the instrument is not in operation.

Environmental Specifications

Operating Temperature
+10 °C to +40 °C (Except temperature 16 °C to 40 °C)
+50 °F to +104 °F

Storage Temperature
-20 °C to +50 °C
-4 °F to +122 °F

Relative Humidity
15% to 90% (non-condensing)

Operating Altitude
-170 m to +4877 m
-557 ft to +16,000 ft

Identification Label and Serial Numbering System Defined

The identification label for the 52000 Series Vital Signs Monitor is shown below. It is located on the bottom of the unit.

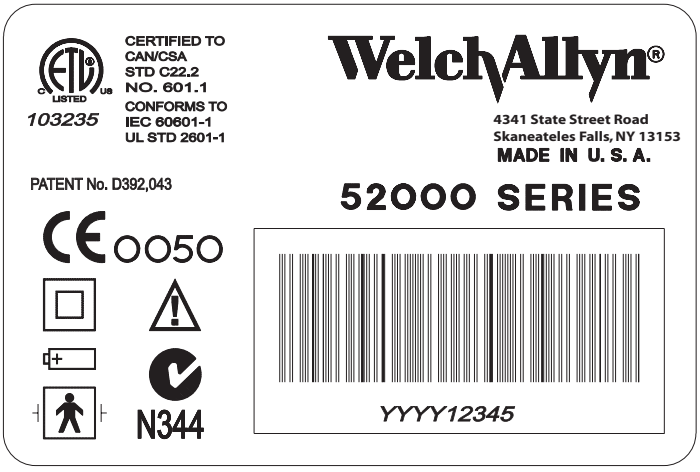


Figure 1-2. Serial number label.

The serial number for the device would consist of nine (9) numbers and a bar code. These would be located in the square below the words "**52000 SERIES**". An example of the number and the explanation is shown below:

200200001

The four digits on the left are the year of manufacture of the device.
The five digits on the right are the sequence of build starting with 00001 annually.

(The example number above would be the first unit built in 2002)

Firmware Identification

To confirm the software levels of the Vital Signs Monitor, place the unit into the **Configuration Test** mode by holding down the "**Start**" button while the unit is being powered up.

The main software versions will appear as follows:
- The main unit software will appear in the Systolic and Diastolic windows.
- The SpO_2 option and temperature option (if installed) will appear in the SpO_2 and Temperature displays.

Note: *Verify the firmware levels listed in Appendix D.*

Tools required for Service

Table 2-1. Tools required for calibration and repair of the Vital Signs Monitor

DESCRIPTION	TOOL #	Manufacture
100 cc Test Volume	T112819	Welch Allyn (6 week lead time)
250 cc Test Volume	T112818	Welch Allyn (6 week lead time)
500 cc Test Volume	T112854	Welch Allyn (6 week lead time)
Bulb and valve	5088-01	Welch Allyn
Pneumatic tubing (3 ea.)	5089-12	Welch Allyn
Test Cable (IR)	66P824	Welch Allyn
Test Cable (Service Cable Kit)	130S60	Welch Allyn
Repair software	130S57E	Welch Allyn
Welch Allyn 9600 Calibrator	01800-210	Welch Allyn
Welch Allyn calibration key	06137-000	Welch Allyn
Spot Service Manual	4200-145E	Welch Allyn
Pneumatic clamps (3)	21730-001	VWR Scientific 800-932-5000
Pliers		Tool/Supply Store
Wire cutter		Tool/Supply Store
Tweezers		Tool/Supply Store
Torque bit (T8)		Tool/Supply Store
Phillips screw driver		Tool/Supply Store
T10 torx bit		Tool/Supply Store
3/8 hex socket		Tool/Supply Store
Cable tie tool		Tool/Supply Store
Setra pressure meter (0-10 PSIG)	2270-01	Setra 800-257-3872
Netech pressure meter	200-2000IN	Netech 800-547-6557
Nellcor patient simulator	SRC-2 for MP205	Nellcor 800-635-5267
Nellcor patient simulator	SRC-MAX for MP506	Nellcor
Nellcor test cable	8-Dec	Nellcor
Digital timer	8456T12	McMaster Car 404-346-7000
"Y" fitting	9586TPK4	Festo 704-527-1427
"T" fitting (3)	9585TPK4	Festo

IBM compatible 486 133 MHz computer or better. The computer must have Windows 95 with a serial port. CPU must have 8 Megabytes of RAM.

2 Digital Multi-Meters. These meters must have 4 1/2 digit displays for accuracy.

Power Supply. 0-20 Vdc adjustable with 0-3A output.

Test Equipment Bench Layout

Figure 2-1 depicts recommended layout of test equipment and special tools required for service and re-calibration of the Vital Signs Monitor.

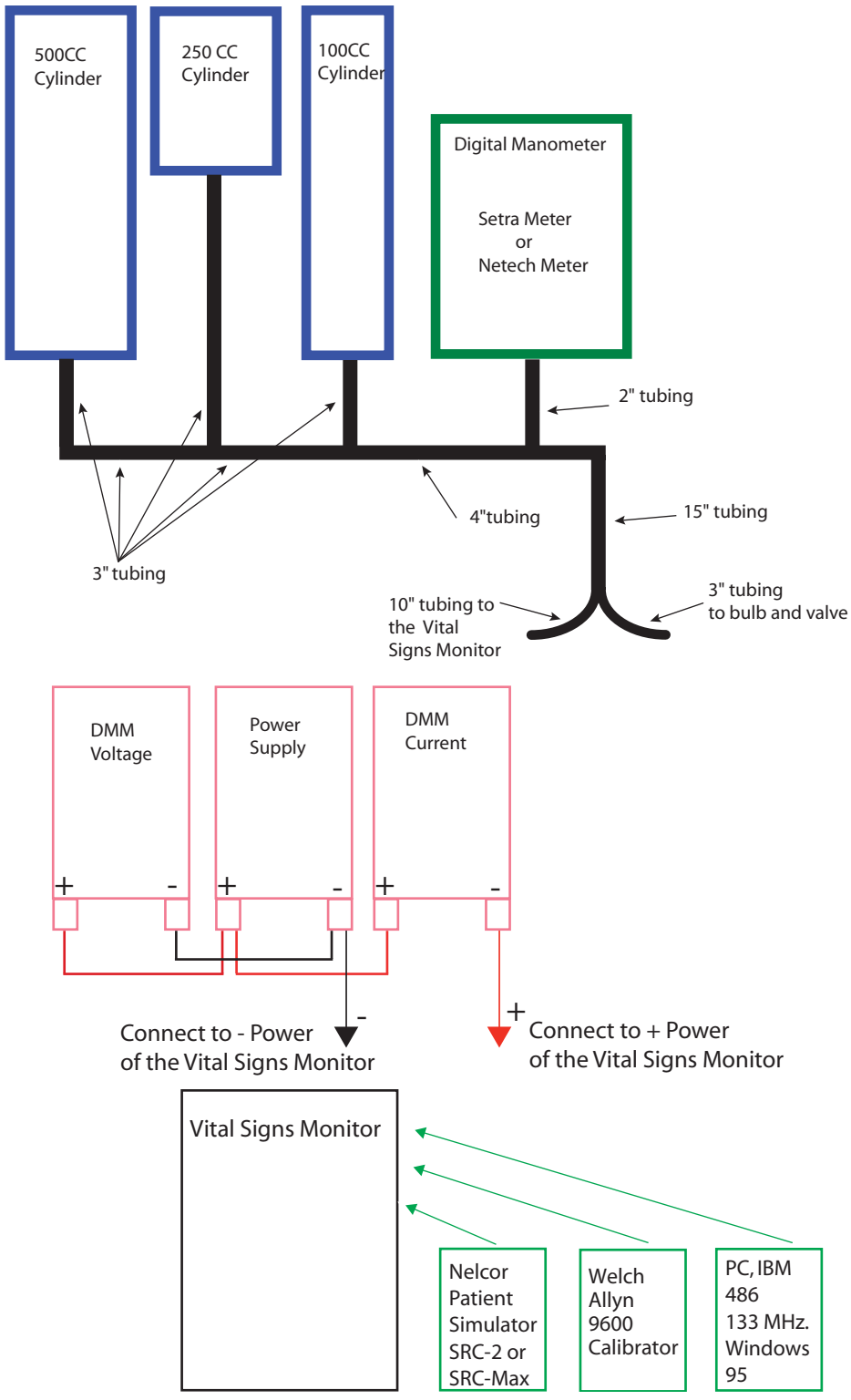


Figure 2-1. Bench layout for re-calibration and testing of the Vital Signs Monitor.

Voltage Calibration

1. Connect the unit to the test station by hooking up the pneumatic tubing. Connect the cable from the PC. Remove the battery and connect the power supply.

2. Place the unit into the "detailed test mode" by holding down the "**Start**" and "**Cancel**" button while powering up the unit. Allow the software versions to be displayed then press the review button until the unit displays "BAT" in the Systolic window.

3. Go to the repair software and select "**Calibrate|Voltage**".

4. Adjust the power supply to 5.6 Vdc (+0.3 / -0.0 Vdc).

5. View the digital multi-meter (DMM) that is connected to the power supply. Read the voltage. Move the cursor to the "Calibrated Voltage" box and type in the voltage that you observe on the DMM. In the software, select "**Update.**"

6. The software will then prompt you to enter a "Calibration Signature." Move the cursor to the box and enter the three initials of your name or three letters of your facility. Select "**OK.**"

7. At this point, you should see the voltage on the display of the unit change to match that of the DMM.

8. Re-adjust the power supply to 6.5 Vdc ±0.25 Vdc.

Pressure Calibration

1. Connect the unit to the test station by hooking up the pneumatic tubing. Connect the cable from the PC. Remove the battery and connect the power supply.

2. Place the unit into the "detailed test mode" by holding down the "**Start**" and "**Cancel**" buttons while powering up the unit. After the software versions is displayed, press the "**Review**" button until the unit displays "**CAL**" in the LCD window.

3. Go to the repair software and select "**Calibrate|Manometer**".

4. Select the "**calibrate**" button to begin the calibration procedure.

5. The software will perform an auto-zero. If this is unsuccessful, the user will be prompted to perform a zero potentiometer calibration. This is an automatic calibration. The user just needs to answer YES or NO. A NO will cancel the calibration procedure.

6. Once the auto-zero is completed successfully, the "Gain Calibration @ 200 mmHg" box is activated. This box consists of a slider control and a pressure display. To perform the span calibration, inflate the unit, using the bulb and valve, to 200 mmHg ± 5 mmHg. Wait 15 seconds to allow the pressure to stabilize. Adjust the slide control of the software until

the reading on the PC matches as close as possible to the reading of the pressure meter. Once the difference has been minimized, select "**record**" and proceed following the directions of the software.

7. Once the gain calibration is complete, the pressure calibration points can be calibrated. There are three points that require calibration; 95, 195 and 285. First set the pressure to the desired pressure value within ± 5 mmHg. Wait 15 second for the pressure to stabilize. Adjust the slide control of the software until the reading on the PC matches as close as possible the reading of the pressure meter. Once the difference has been minimized, select "**record**" after each setting. **YOU MUST DO THIS FOR ALL THREE VALUES.** Once this is completed, select the "**update**" button.

8. The software will respond by asking, "Are you sure?" and then asking for a calibration signature (your initials or three letters of your facility). Select "**OK**".

9. Select "**close**" to exit the calibration dialog box.

10. Cycle power to the unit for the changes in the calibration to take effect.

Loading Unit Software

WARNING! DO NOT REMOVE POWER OR TURN OFF THE UNIT DURING THE SOFTWARE LOADING OPERATION! The unit will be in an unrecoverable state if this happens!

NOTE: *If the computer or the software malfunctions during the software loading operation, re-boot the computer, re-start windows and start the Repair Software. The Repair Software will start in the "Recovery Mode." The software will prompt you to continue/resume the software loading process.*

1. Plug the wall transformer into the Vital Signs Monitor.

2. Connect the unit to the RS232 cable of the test station.

3. Start the Repair Software by clicking on its icon. Go into **Unit/Update Software**.

4. Select "**Select File**" button in the software.

5. Select the correct unit software (zenXXX.mot) file per instructions from the manufacturer. (Where "XXX" is the number of the software version to be loaded)

6. Once the software file is selected, press the "**OK**" button. This will return you to the Repair Software. The Repair Software will then ensure that the zenXXX.mot file you are about to load into the unit is "Valid." If so, press the "**Load**" button in the software.The unit will take about 10 minutes to load the software. If the software file you have chosen is "Not Valid," repeat steps 4 and 5, select the correct version and then proceed. If problems persist, please contact your nearest Welch Allyn Regional Service Center.

Diagnostic Procedure for Returned Units

Notes:
*A. The word "**unit**" in this text refers to the Vital Signs Monitor.*

*B. "**Menu|Choice**" represents menu commands. Rather than use the phrase "choose the exit command from the File menu."*

Battery Voltage Check

1. Remove the battery from the unit. With a digital multi-meter, check the voltage of the battery. If the voltage of the battery is less than 6.0 Vdc, the battery needs to be charged. Recharge the battery by placing the battery back into the unit and plug in the charger. Let the battery charge for 8 hours. Allow the unit to set for 1 day and recheck the battery voltage. If the voltage is below 6.0 Vdc, replace the battery.

2. Remove the battery from the unit. Connect the unit to the power supply. Set the power supply to 6.5 Vdc ± 0.25 Vdc. Power up the unit. If the unit does not power up:
   A. Ensure that the power supply is connected to the unit and turned on.
   B. Check that the fuse is not blown.
   C. Change the main PCB.
   D. Change the display PCB.

LED Functional Check

3.To check the display PCB, observe the unit during power up. All of the LED segments should be lit for 1-2 seconds before the unit gets to its normal mode. If the unit has any LED segments out, change the display PCB.

BP Functional Check

4. Run a couple of blood pressure cycles to ensure proper inflation/deflation and readings.

5. If the unit is not inflating/deflating properly:
   A. Open up the unit by removing the 6 housing screws.
   B. Check the unit for pinched tubing if the unit is deflating too slowly. With the housing opened, re-run the blood pressure cycle to see if the deflating problem has been fixed. Re-route tubing if pinch is found.
   C. If there are no pinched tubes, change the valve.
   D. If this still does not clear the problem of deflation too slow, check to ensure there are no blockages of the tubing/port/valve in the unit.
   E. Power down the unit. Place unit into configuration test mode by holding down the "**Start**" and "**Cancel**" button as power is re-applied. Press the "**Review**" button until "CALCAL" appears in the systolic window. Press the "**Start**" button to close the valve. Inflate the unit, using the bulb and valve, to 250 mmHg. Confirm the unit meets the specification for leaking called out in the Repair Test Specifications in Appendix D. If the unit is leaking continue with step F.

F. Pinch off the tubing leading to the pump. If this stops the leak, change the pump.
G. Pinch off the tubing leading to the valve. If this stops the leak, change the valve.
H. Pinch off the tubing leading to the transducer. If this stops the leak, change the Main PCB.

6. If the unit is inflating/deflating properly and if there is no reading given, change out the main PCB.

Printer Functional Check

7. Load the printer with paper if there is no paper. Press the "**form feed**" button to see if that will advance the paper. Next, press the "**Print**" button to see if the unit will print. If these functions do not work, first change the printer PCB and re-test. If the problem is still evident, change out the printer itself.

SpO_2 Functional Check

8. Connect the correct patient simulator to the unit SpO_2 connection by either the Nellcor SpO_2 test cable or the Nonin SpO_2 test cable. Confirm readings meet the specifications called out in the Repair Test Specifications in Appendix D. If there is no reading, change out the SpO_2 PCB.

Temperature Functional Check

9. Remove the temperature probe and view the temperature window on the display. Make sure the temperature is in the "monitor mode." This will be displayed beside of the temperature window. If the unit is not in monitor mode, wait approximately 40-60 seconds and the unit will automatically transfer into the monitor mode. Using the Welch Allyn 9600 calibrator set at 96.4 °F/ 35.8 °C or using a water bath between 84 °F and 106 °F, place the probe into the small hole on top of the 9600 calibrator or into bath. If there is no reading place the probe back into its housing, remove and retry. If there is still no reading, change the probe and retry the test. If there is still no reading place the probe back into the housing, unplug the probe and plug in the CAL-KEY (5200-25), remove the probe and confirm reading meets specifications called out on the Repair Test Specifications in Appendix D. If there is no reading at this point, change the temperature connector PCB and Temperature PCB.

Communication Functional Check

10. Select Tools|Options to ensure that the communication port that the cable is connected to is selected. Select "**Test**" and ensure that the Vital Signs Monitor responds accordingly. If an error is present, ensure that the communication cable is connected to the Vital Signs Monitor. Re-try the test. If the error is still present, first, change the communication cable. If the error is still present, then change out the main PCB.

Calibration Tests

Note: *The following are the test procedures for the Welch Allyn Vital Signs Monitor. We set these procedures up so that you can start at section 3 and go straight through the procedures or you can skip around. However, you must complete each step called out in this section before a unit can be returned to service.*

Notes:
A. The word ***unit*** *in this text refers to the Welch Allyn Vital Signs Monitor.*

B. ***Menu|Choice*** *represents menu commands. Rather than use the phrase "choose the Exit command from the File menu."*

1. Remove the battery. Connect the unit to the power supply and to the digital voltage meter. Power supply should be set at 6.5 Vdc.

2. Connect the Welch Allyn Vital Signs Monitor to the manual test station (see Section 2). Hook up the pressure lines to the tubing of the monitor and the RS 232/service port connector to the computer. Start the computer program by double clicking on its program icon.

3. Turn on the unit. In the program select "**Unit|Information**". Confirm that the information displayed on the screen matches that of the unit under test.

Note: *If the software returns an ERROR message, check the communications link and re-send the command. If the communications return another error, close the information dialog box then select* ***Tools|Options*** *and check that the correct communications port is selected.*

4. Place the unit into the "**Detailed Test**" mode by holding down the "**Start**" and "**Cancel**" buttons as power is applied.

5. Observe the unit. Verify that the software versions displayed on the LED displays meet the specifications called out in the Repair Test Specifications in Appendix D.

6. Press the "**Review**" button on the unit. The systolic window should read "**CAL.**"

7. Clamp off the 100 cc cylinder and the 250 cc cylinder. Remove the clamp going to the 500 cc cylinder tubing.

8. Select "**Test|Calibration**". The dialog box will display the units primary and safety transducer manometer readings, unit battery reading, valve and pump status.
Note: *Use "****Start****" button to close valve, and hand bulb to set the pressure.*

9. Verify that the unit is within calibration specification at all the following target pressures: 0, 50, 150, and 250 mmHg. All target pressures have a tolerance of ±5 mmHg. Specifications are in Appendix D.

10. Press the "**Review**" button until the systolic window reads "**bat.**"

11. Set the power supply to 5.6 Vdc (+0.3/ -0 Vdc). Verify that the voltage reading of the unit meets the specification called out in the Repair Test Specifications in Appendix D. Return the power supply to 6.5 Vdc ±0.25 Vdc upon completion of this test.

12. Press "**Close**" to exit from the "**Test Calibration**" dialog box.

Current Tests

1. Connect the Welch Allyn Vital Signs Monitor to the manual test station. Hook up the pressure lines to the tubing of the monitor and the RS 232/service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Turn unit off unit then re-power unit allowing the unit to boot up into its normal mode.

3. Click on **Test|Current Levels**. Check the following current levels:
   A. Blank
   B. Idle
   C. Pump
   D. SpO_2
   E. Temperature

4. Verify these currents meet the specifications called out in the Repair Test Specifications in Appendix D.

5. Press "**Close**" button to exit dialog box.

Noise Levels

1. Connect the Welch Allyn Vital Signs Monitor to the manual test station. Hook up the pressure lines to the tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Click on **Test|Noise Levels**.

3. Press "**Test**" button to retrieve the units internal pressure channel noise level. Verify that the noise level meets the specification called out in the Repair Test Specifications in Appendix D.

Button Test

1. Connect the Welch Allyn Vital Signs Monitor to the manual test station. Hook up the pressure lines to the tubing of the monitor and the RS 232/service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Select "**Test|Button Test**". Press each button and ensure that the computer acknowledges it, via the "Button Pressed" display. Each button should also cause the unit's display to change to one of the settings as noted in Table 3-1.

Table 3-1. Button press response table.

Button Pressed	Key Response
Power	0
Start	1
Cancel	2
Review	3
Auto	4
Silence	5
Down	6
Up	7
Select Alarm	8
Volume	9
Feed	F
Print	P
Invalid Response	E

F,P - When printer option is installed
E - Usually multiple keys pressed.

3. Press "**Close**" button to exit from dialog box.

Print Quality

1. Connect the Welch Allyn Vital Signs Monitor to the manual test station. Hook up the pressure lines to the tubing of the monitor and the RS 232/service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Select "**Test|Print Quality**".
Note: *These option will only work when the printer option is installed.*

A. Select "**test pattern 1.**" The printer will print out a pattern of large and small ASCII characters. Verify the quality of the printer output. Once test 1 is complete,
B. Select "**test pattern 2.**" The printer will print out a solid gray field. Verify the quality of the printer output.
C. Select "**Standard Pattern**". The printer will print out the Unit serial number and the Unit software version.
D. Select "**Internal Settings**". The printer will print a detailed list consisting of all the VSM internal configuration settings. Check to make sure the print quality is good and that all the configurations have values assigned to them.

Pneumatic Tests

1. Connect the Vital Signs Monitor unit to the manual test station. Hook up the pressure lines to the tubing of the monitor and the RS 232/service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Place unit into the "**detailed test**"mode. Do this by holding down the **"Start"** and "**Cancel"** buttons as the unit is powered up. Clamp off the 500 cc and 250 cc cylinder, leaving the 100 cc cylinder connected to the unit. Press the "**Review**" button until "CAL"

appears. Press the "**Start**" button to close the units valve. Using the hand bulb, inflate the unit to the first test pressure, 250 mmHg ±5 mmHg (245 to 255 mmHg), and wait 15 seconds to stabilize.

3. Select "**Test|Pneumatic**", and then the "**Leak Test**" option. Press the "**Test**" button to perform the first leak test. The test lasts 15 seconds. Once the test is complete the pressure change is displayed in the "Pressure" box. Verify that the leak rate meets the specification called out in the Repair Test Specifications in Appendix D. Press the **"Cancel**" button to open the unit valve and release the pressure.

Note: *The software will verify that the pressure is 250 mmHg ±5 mmHg, before it will begin a leak test.*

4. Open the valve on the bulb and bleed the pressure down to the second test pressure, 50 mmHg ±5 mmHg (45 to 55 mmHg). Wait 15 seconds to stabilize pressure. Press the "**Test**" button to perform the second leak test. The test lasts 15 seconds. Once the test is complete the pressure change is displayed in the "Pressure" box. Verify that the leak rate meets the specification called out in the Repair Test Specifications in Appendix D.

5. Press the **Cancel** button to open the unit valve and release the pressure.

Note: *The software will verify that the pressure is 50 mmHg ±5 mmHg, before it will begin a leak test.*

6. Power down the unit and power the unit back up allowing it to boot up into its normal mode.

7. Remove the clamp from the 250 cc cylinder and place it on the 100 cc cylinder. Select the "**Inflation Test**" option, and press the "**Test**" button. The unit will perform an inflation test. The inflation time is displayed in the "Timer"box. Verify that the inflation time meets the specification called out in the Repair Test Specifications in Appendix D.

8. Remove the clamp from the 500 cc cylinder and place it on the 250 cc cylinder. Select the "**Dump Test**" option, and press the "**Test**" button. The unit will perform a dump test. The dump time is displayed in the "Timer"box. Verify that the dump time meets the specification in the Repair Test Specifications in Appendix D.

9. Disconnect the test equipment pneumatic hose from the unit. Connect the large cuff with tubing to the unit's manifold. Wrap the large cuff around the 500 cc cylinder. Ensure that the white line that runs along the end of the cuff lines up with the "**N**" in the word "**RANGE.**" Select the **Deflation Test** option, and press the "**TEST**" button. The unit will do a normal blood pressure cycle and then display the step pressures in the "Valve Step Array Data" box. Verify that the step array data meets the specifications called out in the Repair Test Specifications document. Select "**Close**" when all tests have been completed.

Fail Safe Testing

1. Connect the Welch Allyn Vital Signs Monitor to the manual test station. Hook up the pressure lines to the tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Place the unit into the "Detailed Test" mode. Do this by holding the "**Start**" and "**Cancel**" button as the unit is powered up. Press the "**Review**" button until "CAL" appears in the systolic window.

3. Select the **Test|Hardware Fail-safe** menu item.

4. Select the "**Over Pressure**" test, remove the cuff from the unit and attach the test station's pneumatic tubing to the unit. Press the "**Test**" button. Using the hand bulb, slowly increase the pressure, while observing the external pressure meter. The unit will return the hardware failsafe condition, E10. At this point, record the highest pressure observed on the external pressure meter. Verify that the over pressure value meets the specification called out in the Repair Test Specifications in Appendix D.

5. Press the "**Review**" button until "LFE" appears in the systolic window.

6. Press the "**Start**" button and allow the VSM unit to test the over 15mmHg fail safe (test 1) and the repeat cycle test (test 2).

7. If no errors appear in the systolic window during the duration of the tests and the unit goes into the "normal" life cycle tests, then the 15mmHg/repeat cycle tests are successful.

8. Press the "**Cancel**" button to stop the "life test." Press **"Review**" button until the software version is seen on the display. Turn unit "off" then back "on" into the normal mode.

SpO_2 Tests

For testing a unit with MP205 SpO_2 module:
1. Connect the Nellcor SpO_2 simulator (SRC2) to the unit with the test cable.

2. Ensure that the simulator is set to:
   A. Rate: 112
   B. Light: High 1
   C. Modulation: High
   D. RCAL Mode: RCAL63/Local

3. Verify the reading of the unit meets requirements when compared to the Repair Test Specifications in Appendix D.

4. Reconnect the SpO_2 sensor. Place the sensor onto your finger. The unit should return a reading if the sensor is OK.

For testing a unit with MP506 SpO_2 module:
5. Connect the Nellcor SpO_2 simulator (SRC-MAX) to the unit with the test cable.

6. Ensure that the simulator is set to:
   A. HR = 60 and 200
   B. SpO_2% = 75 and 90

7. Verify the readings of the unit meets requirements when compared to the Repair Test Specifications in Appendix D.

8. Reconnect the SpO_2 sensor. Place the sensor onto your finger. The unit should return a reading if the sensor is OK.

For testing a unit with the Nonin SpO_2 module:
9. Connect the Nonin SpO_2 simulator to the unit with the test cable. The reading of the SpO_2 should be within the specified range indicated on the simulator.

10. Reconnect the SpO_2 sensor. Place the sensor onto your finger. The unit should return a reading if the sensor is OK.

Temperature Tests

1. Disconnect the temperature probe from the unit leaving the probe in its housing. Place the “CAL key” into the connector. Remove the probe from the housing. The temperature should read the same as what is specified on the "CAL" key. Remove the “CAL” key and reconnect the probe. Place probe back into the housing.

2. Make sure that the unit’s temperature option is in the “monitor mode”. Do this by removing the probe from the housing and observing the temperature display. “Monitor mode” should be seen in the lower right hand side of the display. If this is not seen, wait approximately 60 seconds and the unit will automatically change mode to the “monitor mode”.

3. Set up the Welch Allyn 9600 calibrator. Set the calibrator to 96.4 °F (35.8 °C) or use a water bath between 84 °F (28.8 °C) and 106 °F (41.1 °C). Allow the calibrator to stabilize for three (3) minutes. Place the probe into the small hole in the calibrator. Observe the temperature display. The reading should be within the specified range, within 30 to 45 seconds.

4. Place the probe back into the housing. Set the calibrator to 106 °F (41.1 °C). Allow the calibrator to stabilize for three minutes. Remove the probe from the housing. The unit must be in the monitor mode, if not wait until the unit automatically goes in that mode. Place probe into the small hole at the top of the calibrator. The reading should be within the specified range, within 60 seconds. If using a water bath skip this part of the test.

Nurse Call Testing

1. Power the unit “on.”

2. Using a ohmmeter, place the probes onto pin 7 and pin 8 of the RS232 connector.

3. Ensure that the ohmmeter reads infinite resistance (open circuit).

4. Create an alarm condition E11 by pinching off the pneumatic tube approximately 1 inch from the pneumatic port and pressing the “**Start**” button.

5. Observe the ohmmeter, the meter should read 0.0 ohms (short circuit).

6. Press the “**Cancel**” button to stop the alarm.

7. Observe the ohmmeter again. The meter should read infinite resistance (open circuit).

Self Diagnostic Fault Codes

The following is a list of all possible error codes and their meanings.

Main Board/Blood Pressure Error Codes

Table 3-2. Main board/blood pressure error code table.

ERROR CODE	DESCRIPTION
C01	User Abort
C02	Auto-Zero Failure
C03	Inflation Too Rapid
C04	Excessive Inflation Time
C05	Excessive Noise
C06	Outside Measuring Range
E10	Over Pressure Violation
E11	Internal Safety Violation
E12	Ambient Temperature Out of Range
E13	Battery Failure
E15	Over 15 mmHg test error
E16	Repeat cycle test error
E20	Missed A/D Sample
E30	ROM Failure
E31	SRAM Failure
E32	Factory EEPROM Checksum Failure
E33	User EEPROM Checksum Failure
E34	A/D Converter Failure
E35	SpO_2 PCB Failure
E36	Temperature PCB Failure
E37	Printer Failure
E38	Real Time Clock Failure
E39	No Calibration Signature

SpO_2 Error Codes

Table 3-3. SpO_2 error code table.

ERROR CODE	DESCRIPTION
E7	Internal Malfunction
C8	Bad Sensor or Wrong Sensor (MP506)
C6	SpO_2 Heart Rate out of range (MP506)

Temperature Error Codes

Table 3-4. Temperature error code table.

ERROR CODE	DESCRIPTION
E0.1	Probe Heater Accumulator
E0.2	Probe A/D Pulse Width Error
E0.3	Adaptive Probe Gain too High or Low
E1.1	Ambient temperature too high
E1.2	Ambient temperature too low
E2.1	Battery Low
E3.1	RAM read/write error
E3.2	ROM checksum error
E3.3	CPU instruction error
E4.0	PTB resistor A/D pulse width error
E4.1	RatioCal resistor A/D pulse width error
E4.2	External Ambient Thermistor A/D pulse width error
E5.0	Heater Circuit error
E5.1	Heater overheated error
E5.2	Heater watch dog time out
E6.0	PTB resistor “temperature” error
E9.1	Communication Error
C20	Broken Probe
“P”	Loss of Tissue Contact
E12	Ambient temperature limit

Temperature Error Code Correction

1. Turn the unit off.

2. Hold down the "**Start**" button as you turn the unit back on. Continue to hold down the "**Start**" button until the alarm signals dissipate.

3. Once the software versions of the unit appear, press the “**Review**” button until three dashes (- - -) are seen in the Temperature window.

4. Once this has been confirmed, press the “**Review**” button until the software versions of the unit are seen once again in the appropriate windows.

5. Turn the unit off, and then turn the unit back on allowing it to boot up in the normal mode.

6. Remove the probe from the housing. You should see "188.8" then "ORL" appear. If this does not occur, please contact your local Welch Allyn Service Department.

Complaint / Cause / Corrective Action

Table 3-5. General Guide to Problems and Corrective Actions.

Symptom	Possible Causes	Explanation and Corrective Action
1. Inaccurate blood pressure readings ***Please Note:*** *Differences of up to 10mmHg is considered normal and will occur for a number of reasons including intrapatient BP variability, observer hearing differences, and ausultatory deflation rate.*	**Incorrect cuff size** ***Note:*** *Use only Welch Allyn approved cuffs*	**Determine correct cuff size:** • Use reference marking on cuff. • Measure patient's arm circumference midway between the elbow and the shoulder. (See "Chart for Determining Cuff Size" in the Operation Manual, to select the correct cuff size.
	Patients arm position	Ensure patients arm is at heart level
	Arm movement during blood pressure cycle	**Keep arm still during blood pressure cycle:** • Movement may cause inaccuracies from artifact.
	Blood pressure taken over clothing	Blood pressure should be taken on a bare arm.
	Arrhythmia	**Check for regularity of heart rate:** (Palpate pulse or check with ECG monitor) • Moderate to severe heart rate irregularities may make blood pressure difficult to measure.
	Incorrect reference	**Use the correct Korotkoff sound to determine diastolic blood pressure.** Many listeners incorrectly equate diastolic blood pressure with the disappearance of sound only (Phase 5). The Welch Allyn Vital Signs Monitor was developed using the American Heart Association recommendations, which state that phase 5 be used unless sound continues to 0 mmHg, in which case the change in the quality of sound (phase 4) is to be used. **Deflate cuff no faster than 3 mmHg per second:** • One of the major sources of error in auscultatory blood pressure measurement is deflating the cuff too quickly. The American Heart Association recommends deflation no faster than 3 mmHg per second. Only use a sphygmomanometer that is known to be in calibration: • Blood pressure taken with an un-calibrated sphygmomanometer may be very inaccurate.
	Change in blood pressure from auscultatory reading to Welch Allyn Vital Signs Monitor reading	Check blood pressure immediately prior to Welch Allyn Vital Signs Monitor reading.
	Poor auscultatory sound recognition by observer	Use higher quality stethoscope. Have a different observer check patient's blood pressure.

Table 3-5. General Guide to Problems and Corrective Actions.

Symptom	Possible Causes	Explanation and Corrective Action
2. Cuff inflation & deflation with no blood pressure readings displayed (or error code in display)	Leak in pneumatic system	**Ensure all cuff attachments are tight.** Carefully check for tubing leaks in blood pressure cuff and tubing attachment to monitor.
	Arm movement during cycle	**Keep arm still during blood pressure cycle.** •Movement may cause inaccuracies from artifact.
	Tubing movement artifact	**Do not contact tubing during blood pressure cycle.** • Movement may cause inaccuracies from artifact
3. No cuff inflation	Connections from monitor to cuff loose	Check all connections. (Do not over tighten).
4. Temperature Malfunction	Broken probe	Replace probe. Consult Technical Manual. Notify Biomedical department or Welch Allyn Technical Support. Wait for display window to read OrL before placing probe.
	Improper probe placement	Place probe in most posterior sublingual pocket. Notify Biomedical department or Welch Allyn Technical Support.
	Probe not replaced	Replace probe in holder prior to taking another temperature.
5. SpO_2 Malfunction • Sensor in place but no SpO_2 on display • Inaccurate SpO_2 reading	Improperly attached sensor	Insert the patient's finger completely into sensor
	Cable incorrectly plugged into monitor.	Ensure sensor cable is correctly plugged into monitor.
	$Sp0_2$ disabled	Ensure $Sp0_2$ is enabled. (check Configuration Mode)
	Incorrect Sensor	Ensure that correct manufacturers sensor is in used. • Nellcor sensors are not interchangeable with NONIN sensors
6. Printer Malfunction	Paper will not advance	Consult Technical Manual. Notify Biomedical department or Welch Allyn Technical Support.
7. Monitor will not turn on.	Low battery	Check connections between monitor and transformer, and transformer and wall receptacle.
	Monitor not powering up	Unplug unit from wall receptacle and check for breaks in cord. If connections secure, check electrical outlet. • Charging light will be on if connections are OK and the monitor is plugged into a working outlet Notify Biomedical Department or Welch Allyn Technical Support.

Table 3-5. General Guide to Problems and Corrective Actions.

Symptom	Possible Causes	Explanation and Corrective Action
8. Cuff to tight *(Over Inflation)*	Pressure Preset too high	Check default Pressure Preset setting: (in Configuration Mode) • Unless patient has underlying systolic hypertension, set pressure preset at 160 mmHg. (If systolic blood pressure greater than pressure preset, monitor will automatically increase an additional 40 mmHg)
9. Cuff popping off	Inappropriate size cuff	Determine cuff size with the cuff markings or refer to chart in Operator's Manual for determining cuff size. • If cuff continues to pop off, notify Biomedical Department or Welch Allyn Technical Support.
	Cuff applied inside out	Re- apply cuff. Make sure Welch Allyn label is facing away from arm.
10. Cuff deflating to slowly	Normal operation	Typical time to take a reading is 20 to 45 seconds. 165 seconds is the maximum.
	Pressure Preset too high	Check default Pressure Preset setting. (in Configuration Mode)
	Patient movement	Have patient sit still. Do not have arm tight against chest wall as respirations may affect speed and accuracy of blood pressure measurement.
	Small leak in pneumatic system	Check cuff and tubing for leaks.

Front Housing

Note: *Opening up the front housing is necessary when replacing the main fuse. Complete removal of the front housing is necessary to replace the main printed circuit board (PCB), display board, switch pad and other components.*

Preparing the unit for disassembly:

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws.

9. Carefully separate the front and rear housings.

Disconnection of connectors:

10. Disconnect the connector (red) from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure lines from transducers.

13. Disconnect the printer flex circuit from the main board.

14. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

15. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

16. Disconnect the temperature PCB.

17. Remove the main PCB by removing the 7 torx screws with the torx t8 bit.

18. Disconnect the flex cable that connects to the display PCB.

19. Remove the main PCB.

20. Remove the 7 gray spacers.

21. Remove the display PCB from front housing.

Note: *The front housing is now free.*

Note: *Replace the front housing by assembling in reverse order following these special instructions.*

Reconnecting the connectors:

25. Reconnect the green wire 2-pin connector to the two male pins on the main board with the wire contact (away from) the temperature board.

26. Carefully align all other connectors and flex circuits in mating connectors. Reassemble in reverse order. No special techniques required.

Verification of repair:

27. Switch the unit to "**on**" and perform a full functional check.

Main PCB

Note: *Removing and replacing the main PCB requires that you remove the battery, split the cases, unplug one pneumatic line and electrical connectors. The small temperature board will be removed in the process. It can be swapped over to the replacement main PCB. It is held on by two of the seven torx fasteners.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door with the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws with the Phillips bit.

9. Carefully separate the front and rear housings.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free of the rear housing.*

Removal of temperature board from main PCB:

10. Unscrew two torx fasteners with the torx t8 bit, lift the temperature board up and remove.

11. Separate the main PCB from the display PCB.

12. Unplug the main PCB to display PCB flex circuit.

13. Remove five (5) remaining torx fasteners with the torx t8 bit and lift the main PCB out of the front housing. Watch for the 7 gray spacers.

Note: *Reassemble in reverse order with attention to the following details.*

Attaching the temperature board to the main PCB:

14. Make sure all of the seven (7) gray plastic board spacers are in place before placing the main PCB over the display PCB.

15. Insert and tighten five of the last fasteners that were removed.

16. Place the temperature board onto the main PCB and secure it with two torx fasteners.

17. Reconnect the temperature board connector to the main PCB socket.

Note: *Reassemble in reverse order.*

Verification of repair:

18. When completely assembled, switch the unit to "**on**" and perform a full functional check, including recalibration.

DC to DC Converter (SpO_2 Units Only)

Note: *To replace the DC to DC converter, it is necessary to remove the main PCB.*

Preparing the unit for disassembly:

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door with the #4 Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

7. Opening front housing.

8. Position unit so the front panel is facing down.

9. Remove six (6) Phillips screws with the Phillips bit.

10. Carefully separate the front and rear housings.

Disconnection of connectors:

11. Disconnect the connector (red) from top of main board to relieve strain.

12. Unplug main 14-pin connector (red) from center of main PCB.

13. Disconnect pressure lines from transducers.

14. Disconnect the printer flex circuit from the main board.

15. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

16. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free of the rear housing.*

17. Separating the main PCB from the display PCB.

18. Unplug the main PCB to display PCB flex circuit.

19. Remove seven (7) torx fasteners with the torx t8 bit and lift the main PCB and the temperature PCB out of the front housing.

Replacing the DC to DC converter from the main PCB:

20. Peel off the rtv surrounding the old converter.

21. De-solder the old converter.

22. Clear the 8 holes out with a thru-hole solder sucker.

23. Install a replacement converter as per Figure 4-1 below.

24. Secure with rtv (innerbond i-45) on all four sides.

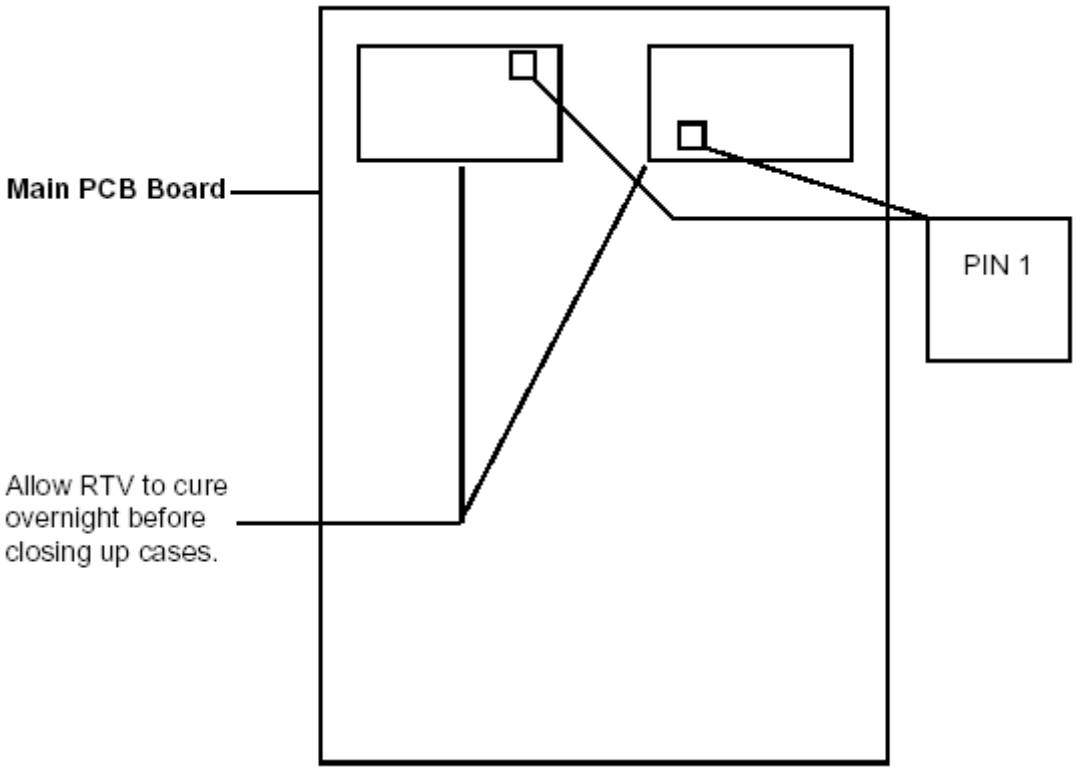


Figure 4-1. DC to DC replacement.

Note: *Reassemble in reverse order, no special techniques required.*

Verification of repair:

25. When completely assembled, switch the unit to "**on**" and perform a full functional check, including recalibration.

Pressure Transducers on Main PCB

Note: *To replace the pressure transducer on the main PCB, it is necessary to remove the main PCB.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door with the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws with the Phillips bit.

9. Carefully separate the front and rear housings.

Disconnection of connectors:

10. Disconnect the connector (red) from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure line from transducers.

13. Disconnect the printer flex circuit from the main board.

14. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

15. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free of the rear housing.*

16. Separating the main PCB from the display PCB.

17. Unplug the main PCB to display PCB flex circuit.

18. Remove seven (7) torx fasteners with the torx t8 bit and lift the main PCB and the temperature PCB out of the front housing.

19. Do not lose the 7 gray spacers.

Replacing the pressure transducer on the main PCB:

20. De-solder the old transducer.

21. Clear the 6 holes out with a thru-hole solder sucker.

22. Install a replacement pressure transducer per Figure 4-2.

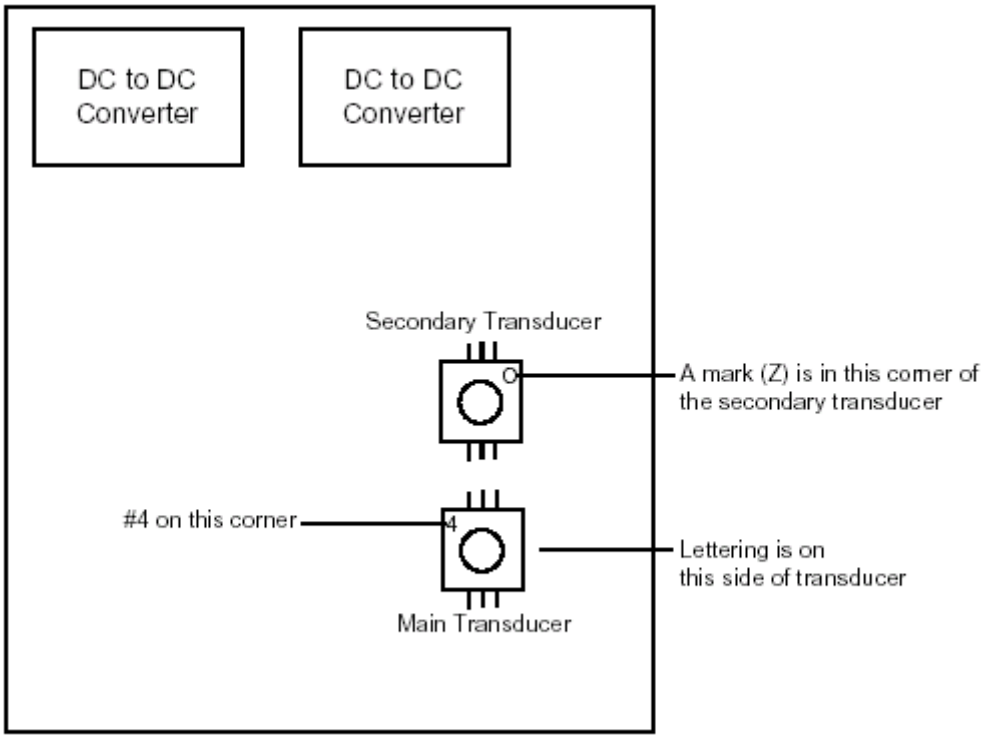

DC to DC Converter
DC to DC Converter
Secondary Transducer
A mark (Z) is in this corner of the secondary transducer
#4 on this corner
4
Lettering is on this side of transducer
Main Transducer

Figure 4-2. Pressure transducer replacement.

Note: *Reassemble in reverse order, no special techniques required.*

Verification of repair:

23. When completely assembled, switch the unit to "**on**" and perform a full functional check, including recalibration.

Display PCB Removal

Note: *Removing and replacing the display PCB requires that you remove the battery, split the cases, unplug one pneumatic line and electrical connectors, remove the temperature PCB and main PCB.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door with the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws with the Phillips bit.

9. Carefully separate the front and rear housings.

Disconnection of connectors:

10. Disconnect the connector (red) from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure line from transducers.

13. Disconnect the printer flex circuit from the main board.

14. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

15. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free of the rear housing.*

Separating the main PCB from the display PCB:

16. Unplug the main PCB to display PCB flex circuit.

17. Remove seven (7) torx fasteners with the torx t8 bit and lift the main PCB and the temperature PCB out of the front housing.

18. Remove the seven (7) gray board spacers as they will be reused.

19. Removing the display PCB from the front housing.

20. Gently lift the display board out of the front housing. Be careful not to damage the exposed LED's.

Note: *Reassemble in reverse order with attention to the following details.*

21. Place display PCB into front housing.

22. Seat the display PCB over screw bosses.

23. Place 7 spacers over front housing bosses projecting through PCB and seat them securely against the surface of the PCB.

Attaching main PCB to the display PCB and front housing:

Note: *Use all seven gray spacers to prevent damage to the boards.*

24. Gently lay the main PCB onto the spacers (component side up) so that all of the holes line up.

25. Insert and tighten five (5) torx fasteners with the torx t8 bit.

Attaching the temperature board (option):

26. Align the temperature board so that the component side faces towards the center of the unit.

Note: *Continue reassembly in reverse order of disassembly.*

Verification of repair:

27. When completely assembled, switch the unit to "**on**" and perform a full functional check, including recalibration.

Key Pad (Switch Array)

Note: *Removing and replacing the key pad requires that you remove the battery, split the cases, unplug one pneumatic line and electrical connectors, and remove the main and display PCB's from the front housing. If the key pad is being removed for suspected moisture or contamination, replace it with a new one once the PCB is cleaned.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door with the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws with the Phillips bit.

9. Carefully separate the front and rear housings.

Disconnection of connectors:

10. Disconnect the connector (red) from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure line from transducers.

13. Disconnect the printer flex circuit from the main board.

14. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

15. Disconnect the green wire 2-pin connector from the main board.

Note *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free of the rear housing.*

16. Separating the main PCB from the display PCB.

17. Unplug the main PCB to display PCB flex circuit.

18. Remove all seven (7) torx fasteners with the torx t8 bit and lift the main PCB and temperature PCB out of the front housing.

19. Remove the seven (7) gray board spacers as they will be reused.

Removing the display PCB from the front housing:

20. Gently lift the display board out of the front housing. Be careful not to damage the exposed led's.

Removing the key pad:

21. Gently peel the old key pad away from the PCB.

22. Inspect the PCB for contamination and clean accordingly with alcohol. Allow the alcohol to evaporate for one minute then blow off lint. From this point on, do not touch contact surfaces.

Note: *Reassemble in reverse order with attention to the following details.*

23. Attach new key pad to the display PCB.

24. Lay flexible key pad over PCB and exactly align protrusions over holes in PCB.

25. Press protrusions into holes with tool. Be careful not to tear keypad.

26. Place display PCB into front housing.

27. Seat the display PCB over screw bosses.

28. Place 7 spacers over front housing bosses projecting through PCB and seat them securely against the surface of the PCB.

Attaching main PCB to the display PCB and front housing:

Note: *Use all seven gray spacers to prevent damage to the boards.*

29. Gently lay the main PCB onto the spacers (component side up) so that all of the holes line up.

30. Insert and tighten torx fasteners with the torx t8 bit.

Attaching the temperature board (option):

31. Align the temperature board so that the component side faces towards the center of the unit.

Note: *Continue reassembly in reverse order of disassembly.*

Verification of repair:

32. When completely assembled, switch the unit to "**on**" and perform a full functional check, including recalibration.

Temperature PCB

Note: *Removing and replacing the Temperature PCB requires that you remove the battery, split the cases, unplug one pneumatic line and electrical connectors. The small temperature board can be removed by unscrewing two Phillips head screws, which hold the board to the two small "l" brackets. It is not necessary to remove the brackets from the main PCB.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door with the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws with the Phillips bit.

9. Carefully separate the front and rear housings.

Disconnection of connectors:

10. Disconnect the connector (red) from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure line from transducers.

13. Disconnect the printer flex circuit from the main board.

14. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

15. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free from the rear housing.*

Removal of temperature board from "l" brackets on the main PCB:

16. Disconnect connector from main board socket.

17. Disconnect the temperature connector cable from the temperature PCB.

18. Unscrew two torx fasteners with the torx t8 bit and lift the temperature board up.

Note: *The temperature board is now free from the main PCB.*

Note: *Reassemble in reverse order with attention to the following details.*

Attaching the temperature board when main PCB was not removed:

19. Place a spacer on each Phillips head screw.

20. Insert screw through board.

21. Place another spacer on each screw.

22. Thread screw into "l" bracket part way.

23. Apply Locktite 222 on the end of the screw and thread all the way into the bracket.

24. Reconnect the temperature connector to main PCB socket.

25. Reconnect the temperature connector cable to the temperature PCB.

Note: *Reassemble in reverse order.*

Verification of repair:

26. When completely assembled, switch the unit to "**on**" and perform a full functional check of the temperature function.

Specific Oxygen Board (Nonin SpO_2 PCB)

Note: *Removing and replacing the Nonin SpO_2 PCB requires that you remove the battery, and remove the front housing.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door with the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws with the Phillips bit.

9. Carefully separate the front and rear housings.

Disconnection of connectors:

10. Disconnect the connector (red) from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure line from transducers.

13. Disconnect the printer flex circuit from the main board.

14. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

15. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free from the rear housing.*

Removing the Nonin SpO_2 PCB:

16. Turn unit on its back and unscrew two torx screws from the board with the torx t8 bit.
17. Disconnect tube from bottom of valve.
18. Disconnect tube from pressure outlet fitting.
19. Slide board out of well.
20. Remove wires from board.
21. Remove rtv from the back side of seven wire solder connections as shown in Figure 4-3.
22. Unsolder wires from board as per Figure 4-3.
23. Remove solder from wires to prepare for new board.

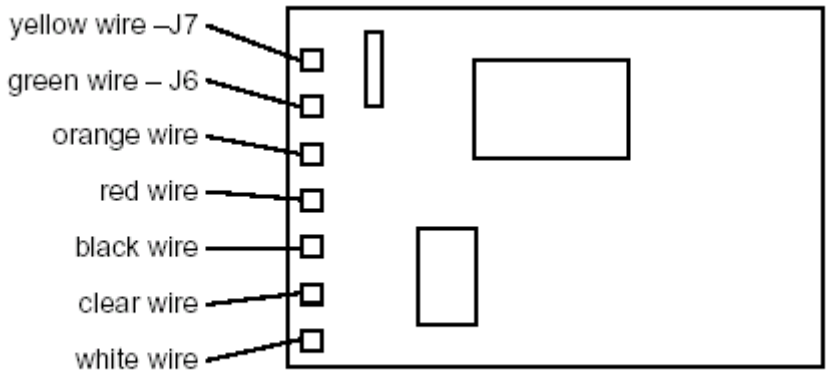


Figure 4-3. RTV removal from NONIN SpO_2 PCB.

Checking wire connections by pin-out process:

Note: *Each wire will terminate at a specific pin position on the SpO_2 jack. Therefore, reconfirm that all connections are correct by pinning out your work. Use Figure 4-4 to verify connections.*

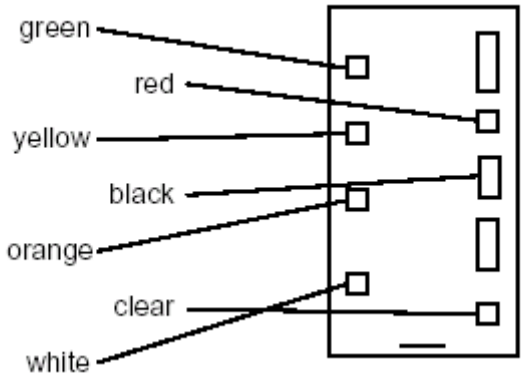


Figure 4-4. SpO_2 jack, wire side.

Replacing the SpO_2 board:

24. Connect wires to locations as shown in Figure 4-4.

25. Cover bottoms of connections with 376e108 (G.E. gray rtv #167, electronic adhesive sealant)

Note: *Reassemble in reverse order of disassembly.*

Verification of repair:

26. When completely assembled, switch the unit to "**on**" and perform a full functional check of the SpO_2 function.

Specific Oxygen Board (Nellcor SpO_2 PCB - MP205 or MP506)

Note: *Removing and replacing the Nellcor SpO_2 PCB requires that you remove the battery, and remove the front housing.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A.If the unit is pole-mounted, remove unit from the pole.
   B. If the unit is wall-mounted, remove unit from the wall.
   C. If the unit is free-standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door with the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws with the Phillips bit.

9. Carefully separate the front and rear housings.

Disconnection of connectors:

10. Disconnect the connector from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure lines from transducers.

13. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

14. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free from the rear housing.*

Removing the Nellcor SpO_2 PCB:

15. Turn unit on its back and unscrew two torx screws (*Use the torx T8 bit)* from the board and lift blue wire.

16. Disconnect tube from bottom of valve.

17. Disconnect tube from pressure outlet fitting.

18. Remove two (2) screws from valve and lift valve,using the torx T8 bit.

19. Lift Nellcor SpO_2 PCB from well.

20. Removing wires from board.

21. Unplug the connector for the main PCB terminator by using a flat head screw driver and gently pry upwards on the connector.

22. Unplug the connector for the outside interface by simply pulling back on the connector.

Note: *The SpO_2 PCB has been removed from the rear housing.*

Replacing the SpO_2 PCB:

23. Connect the main PCB terminator cable connector to its proper port on the Nellcor SpO_2 PCB.

24. Connect the outside interface cable connector to its proper port on the Nellcor SpO_2 PCB.

Note: *Reassemble in reverse order of disassembly.*

Verification of repair:

25. When completely assembled, switch the unit to "**on**" and perform a full functional check of the SpO_2 function.

Pump/Motor Assembly

Note: *Removing and replacing the pump motor assembly requires the removal of the battery and the front housing. The replacement motor comes with an attached wire tie mounting pad.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door using the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws with using the Phillips bit.

9. Carefully separate the front and rear housings.

Disconnection of connectors

10. Disconnect the connector (red) from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure lines from transducers.

13. Disconnect the printer flex circuit from the main board.

14. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

15. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free of the rear housing.*

Removing the old pump/motor:

16. Remove the tubing from the motor. This can also be done after the motor is more accessible when it is out of the rear housing.

17. Place a flat blade screwdriver under the wire tie pad which holds motor in place.

18. Gently remove the motor from the rear housing.

19. Unsolder the orange and white wires from the motor terminals.

20. Remove any residue from the old pad with a flat blade screwdriver.

Installing a replacement pump/motor assembly:

21. Clean the pad mounting area with alcohol prior to soldering. This will allow time for the alcohol to evaporate.

22. Solder the orange wire to the plus (+) terminal of the motor.

23. Solder the white wire to the negative (-) terminal of the motor.

Caution! Be careful in this next step. Do not attach the pump/motor assembly to the rear housing until you are sure it is positioned properly. Keep in mind that the wires are intended to be on the left side of the pump/motor assembly, and that the motor end must not be resting against the back wall of the rear housing.

24. Remove the protective paper from the pad and place the pump motor assembly into the rear housing so that the end of the pump is even with the platform it sits on. This assures that the motor end will not be in contact with the back wall of the rear housing. Be careful to keep the wires away from the adhesive pad. Make sure that the other wires in the area are on the left side of the motor.

25. When everything is aligned, attach the pump/motor assembly to the rear housing by pressing the adhesive pad against the platform.

26. Connect the tube to the barb fitting of the pump.

Note: *Reassemble in reverse order of disassembly.*

Verification of repair:

27. When completely assembled, switch the unit to "**on**" and perform a full functional check and recalibration.

Valve (Pneutronics)

Note: *Removing and replacing the Pneutronics valve requires the removal of the battery and the front housing. The replacement valve attaches with two torx fasteners. Two spade connectors make up the electrical connections. One tube connects to the valve.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door using the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws using the Phillips bit.

9. Carefully separate the front and rear housings.

Disconnection of connectors:

10. Disconnect the connector (red) from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure lines from transducers.

13. Disconnect the printer flex circuit from the main board.

14. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

15. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free of the rear housing.*

Removing the valve:

16. Remove the tubing from the valve.

17. Unscrew two torx fasteners. Use the t8 torx bit.

18. Gently remove the valve from the rear housing.

19. Disconnect the two spade connectors from the valve.

Installing a replacement valve: *See figure 4-5.*

20. Connect the green wire spade connector to the left terminal.

21. Connect the dark brown wire spade connector to the right terminal.

22. Replace two torx fasteners using a torx t8 bit.

23. Connect the tube to the barb connector of the valve.

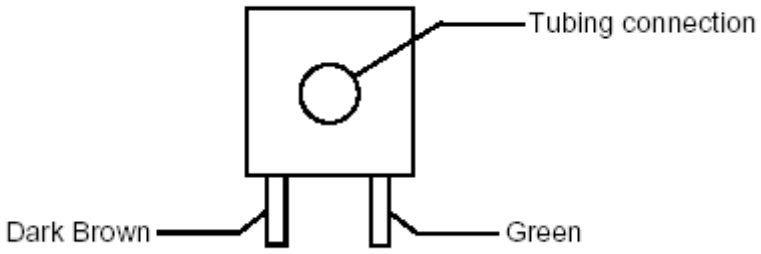


Figure 4-5. Bottom view of valve (Pneutronics).

24. Reassemble in reverse order with attention to the following details.

Placement of wires during reassembly:

25. Make sure the four pin wire harness is routed over and around the valve, and not underneath it.

26. Make sure that no wires are pinched underneath the valve.

27. Make sure that the dark brown and green wires are pushed down into the housing to eliminate any interference with the gears of the printer.

Verification of repair:

28. When completely assembled, switch the unit to "**on**" and perform a full functional check and re-calibration.

Printer/Printer PCB/Keypad

Note: *Removing and replacing the printer /PCB assembly requires the removal of the battery and the front housing. The keypad array can cleaned and or replaced easily without removing the front housing. The printer and the printer PCB are soldered together and are replaced as a unit.*

1. Turn unit off and disconnect AC power cord from the unit.

2. Disconnect all accessories from the unit.
   A. If the unit is pole mounted, remove unit from the pole.
   B. If the unit is wall mounted, remove unit from the wall.
   C. If the unit is free standing, turn the back towards you.

Battery cover removal:

3. Remove four (4) Phillips head screws from the battery door using the Phillips bit.

4. Remove battery door.

Battery removal from battery compartment:

5. Remove the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.

6. Disconnect the two (2) connectors.

Note: *If the battery is to be discarded, comply with all environmental regulations pertaining to battery disposal.*

Opening front housing:

7. Position unit so the front panel is facing down.

8. Remove six (6) Phillips screws using the Phillips bit.

9. Carefully separate the front and rear housings.

Disconnection of connectors:

10. Disconnect the connector (red) from top of main board to relieve strain.

11. Unplug main 14-pin connector (red) from center of main PCB.

12. Disconnect pressure lines from transducers.

13. Disconnect the printer flex circuit from the main board.

14. Disconnect 7-pin connector coming from the temperature connector PCB to the temperature PCB.

15. Disconnect the green wire 2-pin connector from the main board.

Note: *The orientation of the green wire is towards the center of the main PCB, or away from the temperature board.*

Note: *The front housing is now free of the rear housing.*

Remove/clean keypad array:

16. Remove the paper cover.

17. Remove the paper roll.

18. Unscrew two torx fasteners using the t8 torx bit.

19. Gently slide the printer housing cover towards you and disengage the two screw tabs from the rear housing.

20. Very gently roll the printer housing cover up and away from you to gain access to the flex circuits underneath.

21. Disconnect the white flex circuit connector.

Note: *The orientation of the blue color on the connector end of the flex circuit is facing away from you in while you are disconnecting and reconnecting later during reassembly.*

22. Carefully unscrew the five (5) torx fasteners with insulators using the torx t8 bit. Be careful not to tear the copper shield from its connecting wire.

23. Lift up the copper shield and remove the keypad array.

Removing the printer /PCB assembly:

24. Insert a flat blade screwdriver under the printer and pry loose the two doublesided foam tape fasteners.

25. Slide the printer out of the rear housing.

26. Pass the printed circuit board through the opening in the rear housing and completely remove the printer and printer PCB assembly.

Note: *Reassemble in reverse order with attention to the following details.*

Placement of printer in rear housing:

27. When attaching the printer to the rear housing, make sure it is positioned all the way into the recess.

Attaching printer PCB to printer cover:

28. Carefully place the PCB into the cover so that the buttons protrude through the cover. Align the holes in the board with the standoffs on the cover and insert the five (5) screws with plastic insulators.

Verification of repair:

29. When completely assembled, switch the unit to 'on' and perform a full functional check of printer. Re-calibrate.

Battery Placement

1. Lay unit face down on the test bench

2. Remove the (4) Phillips head screws holding the battery cover/handle to the unit using the Phillips bit.

3. Lift cover and remove.

4. Lift battery from housing and disconnect the connectors.

Note: *Reassemble in reverse order.*

Vital Signs Monitor Repair Parts List

Part #	Description	Quantity
106100-5	PHPS 6-32 X .250	3
10P1091	SPACER,PVC,SELF RETAINING	7
113P463	CABLE TIE MOUNT	1
113P464	CABLE TIE, 6 INCH	1
113P480-1	WIRE TIE, 4.0 LONG	1
113P490-1	CLIP,WIRE	1
113P495	SHIELD,MAIN,VSM	1
113S459	CONN,DC POWER JACK,2.5MM	1
113S497	KEY,TEMP PROBE CALIB.	1
114S583	ASSEMBLY,BATTERY,VSM	1
114S586	FUSE,5 AMP,20MM SIZE	1
117S144	DC/DC CONVERTER,5 VOLT	1
125S209A	ASSY,VSM PRINTER BRD	1
125S227	ASSY,VSM,MAIN BRD (Main PCB and software)	1
125S230	ASSY,678 PCB WITH BRACKETS	1
125S231	ASSY,678 TEMP BOARD,(DIATEK)	1
125S232A	ASSY,DISP PWA W/TEMP LEDS	1
125S232B	ASSY,DISP PWA W/O TEMP LEDS	1
125S233	ASSY,TEMP CONN.BOARD,VSM	1
130S14	KIT,REPAIR,BATTERY PLATE	1
130S18	KIT,REPAIR,PRINTER HSG.	1
130S20	OBS.-KIT,REPAIR,NONIN SPO_2 PCB	1
130S29E	S/W,VSM REPAIR,ORDER NO.	1
130S4	KIT,REPAIR,DISPLAY ASSY.	1
130S41	KIT,VSM REPAIR,TUBING ASSEMBLY	1
130S45	KIT,VSM REPAIR,MAIN BOARD (Main PCB, Hardware and software)	1
130S48	KIT,VSM REPAIR,RS232	1
130S5	KIT,REPAIR,VALVE	1
130S50	KIT,VSM REPAIR,NELL CBL MP205	1
130S52	KIT,VSM REPAIR,678 TEMP PCB	1
130S53	KIT,VSM REPAIR,678 TEMP C.B.	1
130S58	KIT, MOUNTING PLATE	1
130S59	KIT, LUG & SCREW	1
130S6	KIT,REPAIR,PNEUMATIC CONN	1
130S64E	KIT,5.17 S/W UPGRADE	1
14P1730	BRACKET,TEMP BOOT	1
14P1734	BRACKET, NELLCOR	1

Part #	Description	Quantity
168S103	KIT,ASSEMBLY,PUMP	1
22P1451	WASHER,FLAT,#4 NYLON	5
22P1451-2	WASHER,#6 FLAT NYLON	3
22P1451-3	WASHER,FLAT,NYLON,.098 X.187	2
22P1456	WASHER,FLAT,.33X.62X.049	1
22P1462	LOCKWASHER,#2 INT TOOTH	1
265E424-1	WIRE CUT TO 1" STRIPPD TO 1/4"	1
29P483	FAIR-RITE BEAD,ROUND WIRE	1
29P486	INSULATION,PCB	1
29P487	INSULATION	1
32P810	NUT,HEX,5/16-32X.095	1
35P1359	HOUSING, REAR	1
35P1360	HOUSING,PRINTER WELL	1
35P1361	HOUSING,THERMOMETER,CBP	1
35P1386	REAR HOUSING MODIFICATION,VSM	1
35P1395	HOUSING, VSM FRONT (MACHINED)	1
421007-1	TRANSFORMER,DOMESTIC,120V	1
421051-10	TUBING,1/8 X 1/4 X 1.15	1
421051-11	TUBING,1/8 X 1/4 X 1.50	1
421051-12	TUBING,1/8 X 1/4 X 2.50	1
421051-9	TUBING,1/8 X 1/4 X 0.95	1
421052-2	TUBING,1/16 X 3/16 X 3.80	1
421052-3	TUBING,1/16 X 3/16 X 4.00	1
421063-502	BOX SET, SPOT	1
43P820	GROMMET,PANEL,.312 ID,BLK	1
45P3286A	LABEL,CONNECTOR,BP	1
45P3286B	LABEL,CONNECTOR,BP/SPO_2	1
45P3286C	LABEL,CONNECTOR,BP/TEMP	1
45P3286D	LABEL,CONN,BP/TEMP/SPO_2	1
45P3294	LABEL,PRINTER PAPER	1
45P3296	SHIELD,ESD,PRINTER	1
45P3320	LABEL,SUB,WHITE,FRONT PANEL	1
45P3321	LABEL,SUB,WHITE,CONNECTOR	1
45P3328-2	LABEL,NELLCOR SENSOR	1
45P3343EA	LABEL,FRONT PANEL,BP,ENGLISH	1
45P3343EB	LABEL,FRT.PANL.BP,SPO_2,ENGLISH	1
45P3343EC	LABEL,FRT.PANL.BP,TEMP,ENGLISH	1
45P3343ED	LABEL,FRONT PANEL,VSM,ENGLISH	1
45P3343FA	LABEL,FRONT PANEL,BP,FRENCH	1

Part #	Description	Quantity
45P3343FB	LABEL,FRT.PANL.BP,SPO_2,FRENCH	1
45P3343FC	LABEL,FRT.PANL.BP,TEMP,FRENCH	1
45P3343FD	LABEL,FRONT PANEL,VSM,FRENCH	1
45P3343GA	LABEL,FRONT PANEL,BP,GERMAN	1
45P3343GB	LABEL,FRT.PANL.BP,SPO_2,GERMAN	1
45P3343GC	LABEL,FRT.PANL.BP,TEMP,GERMAN	1
45P3343GD	LABEL,FRONT PANEL,VSM,GERMAN	1
45P3343IA	LABEL,FRONT PANEL,BP,ITALIAN	1
45P3343IB	LABEL,FRT.PANL.BP,SPO_2,ITALIAN	1
45P3343IC	LABEL,FRT.PANL.BP,TEMP,ITALIAN	1
45P3343ID	LABEL,FRONT PANEL,VSM,ITALIAN	1
45P3343SA	LABEL,FRONT PANEL,BP,SPANISH	1
45P3343SB	LABEL,FRT.PANL.BP,SPO_2,SPANISH	1
45P3343SC	LABEL,FRT.PANL.BP,TEMP,SPANISH	1
45P3343SD	LABEL,FRONT PANEL,VSM,SPANISH	1
45P3345E	LABEL,ERROR CODE,LEFT,VSM	1
45P3345F	LABEL,ERROR CODE,LEFT, VSM	1
45P3345G	LABEL,ERROR CODE,LEFT,VSM	1
45P3345I	LABEL,ERROR CODE,LEFT,VSM	1
45P3345S	LABEL,ERROR CODE,LEFT,VSM	1
45P3347E	LABEL,BUTTON,ENGLISH	1
45P3347F	LABEL,BUTTON,FRENCH	1
45P3347G	LABEL,BUTTON,GERMAN	1
45P3347I	LABEL,BUTTON,ITALIAN	1
45P3347S	LABEL,BUTTON,SPANISH	1
45P3348	LABEL,PRINTER,ENGLISH	1
45P3349	LABEL,VSM,WELCH ALLYN	1
45P3352E	LABEL,ERROR CODE,RIGHT,VSM	1
45P3352F	LABEL,ERROR CODE,FRENCH	1
45P3352G	LABEL,ERROR CODE,RIGHT,VSM	1
45P3352I	LABEL,ERROR CODE,RIGHT VSM	1
45P3352S	LABEL,ERROR CODE,RIGHT,VSM	1
47S1090A	ASSY,PNEUMATIC TUBING,VSM	1
48P381	FITTING, T	1
48P386	FITTING,T,.125 X.063	1
4S307	ASSY. BASKET PLATE	1
51P746	CLIP,NELLCOR SENSOR	1
5200-08	CALIBRATION T FITTING	1
5200-101A	TRANSFORMER,120VAC/60 HZ,8 Vdc	1

Part #	Description	Quantity
5200-103A	TRANSFORMER,220VAC/50 HZ,8 Vdc	1
5200-12	TUBING,LF STRAIGHT 8 FT W/FIT.	1
5200-145E	MANUAL, SERVICE, VSM	1
5200-19	TUBING,STRAIGHT,5 FT.BLACK	1
5200-19M	TUBING,STRAIGHT,5 FT.BLACK-SKF	1
5200-25	CAL KEY,TEMP PROBE CALIB.	1
5200-70	KIT,ANTI-THEFT BLOCK,VSM	1
5200-84	BATTERY,6 VOLT FOR VSM	1
5200-85E	MANUAL,OPER,VSM,ENGLISH	1
5200-86E	MANUAL,SER.ENGLISH VSM	1
520500	SCREW,DB CONNECTOR	2
520501	FLAT WASHER,DB CONNECTOR	4
520502	NUT,DB CONNECTOR	2
59P586	FOOT, RUBBER	1
5P1039	HOUSING,REAR PANEL	1
5P1040	PLUG,TEMP.	1
5P1041	PLATE,BATTERY ACCESS	1
5P1042	PANEL, PAPER ACCESS	1
618E50-1	PACKET,DESICCANT,2 UNIT	1
620026	NONIN SENSOR,SPO_2 FINGER CLIP	1
620028-E	LABEL, CAUTION	1
620036	NELLCOR DURA SENSOR	1
620037	NELLCOR EXTENSION CABLE	1
620038	NELLCOR LABEL (CARTON)	1
620154	NONIN SPO_2 BD W/SHIELD	1
620156	PUMP	1
620157	STEPPER VALVE	1
620158	CHECK VALVE	1
620192-1	PNEUMATIC CONNECTOR	1
620217	FITTING, "T", 1/8 X 1/16X 1/8	1
620377-1	"NELLCOR WORKS HERE" LABEL	1
620388-1	LABEL, NONIN SENSOR	1
620530	D CONN.LOCATOR\NELLCOR MP506	1
620532	NELLCOR MP506 SPO_2 PCB	1
620535	NELLCOR MP506 PATENT LABEL	1
66P812	CABLE,DB9 FEMALE,42IN. LO	1
66S516	CABLE,FLAT,24 CONDUCTOR	1
66S530	CABLE,FLAT,18 COND,7.5 IN	1
66S532	OBS. - CABLE,SPO_2,NONIN	1

Part #	Description	Quantity
66S535	OBS. - CABLE,SPO_2,NELLCOR	1
66S541	CABLE, VSM, J1	1
66S542	CABLE,CHARGER,VSM, J6	1
66S543	CABLE,SERIAL COMM,VSM, J3	1
66S546	CABLE,VSM, J2 NELLCOR SPO_2	1
66S547	OBS. -CABLE,VSM, J2 NONIN SPO_2	1
66S555	CABLE,SPO_2,NELLCOR MP-506	1
74P103	SWITCH ARRAY,FRNT PNL,PRNTR	1
761076-0	POWER CORD, DETACH.(DOM/JAPAN)	1
761076-8	POWER CORD, DETACHABLE (SWISS)	1
761076-9	POWER CORD-DETACHABL-SOUTH AMERICAN	1
76401	POWER CORD - DOMESTIC	1
76402	POWER CORD (EUR)	1
76404	POWER CORD (UK)	1
76406	POWER CORD (AUS)	1
77S587	ASSEMBLY, PRINTER, CBP	1
78P567	FOAM STRIP,.75 SQUARE	1
78P582	FOAM PAD,.875 X 1.19	1
94P5526	POLYBAG,16X16-18	1
95P360E	VSM SERVICE MANUAL (OLD STYLE VSM WITH GRAY SILENCE BUTTON)	1
95P445E	VSM SERVICE MANUAL (NEW STYLE VSM WITH BLUE SILENCE BUTTON)	1
95P471-1	SHEET, REPAIR	1
95P471-2	SHEET, REPAIR	1
95P517E	VSM OPERATOR'S MANUAL	1
9P2489	SCREW,6-32 X .625 FH PH	4
9P2493	SCREW, #4-40 X 0.375 PHP	4
9P2494	SCREW, #4-40 X 0.875 PHP	2
9P2842	SCREW, 2-28 X .312	4
9P2843	SCREW, 2-28 X .50	4
9P2847	SCREW,2-28x.75,TORX PAN H	2
9P2849	SCREW,2-28 X .563	1
OC-3	CABLE,OXICLIQ SENSOR,OC-3	1

Product Structure

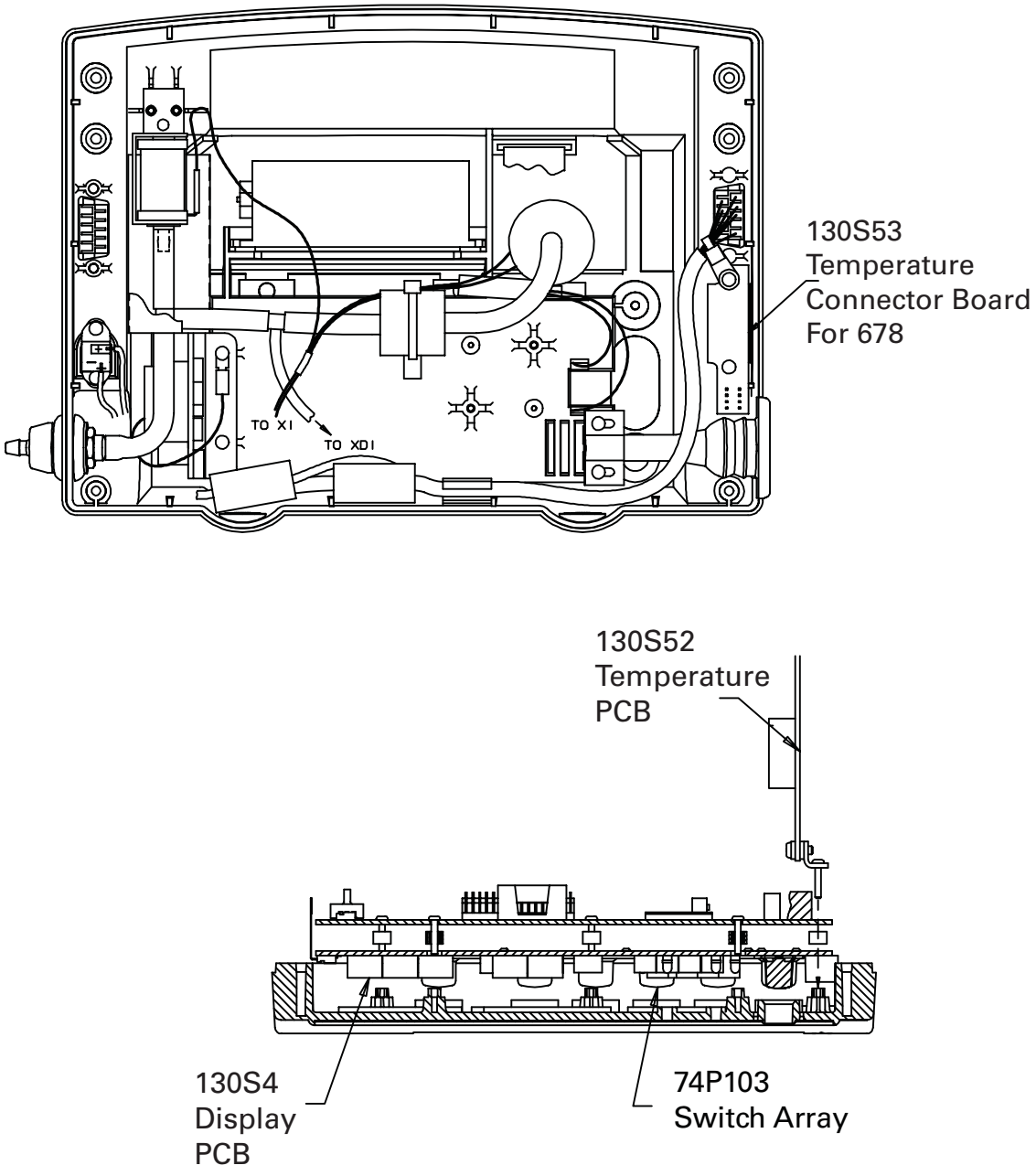
Model	Description
52000	Non-Invasive Blood Pressure only (includes Pulse Rate & MAP)
5200P	NIBP / Printer
520T0	NIBP / Temperature
520TP	NIBP / Temperature / Printer
52S00	NIBP / Nonin Pulse Oximeter
52N00	NIBP / Nellcor Pulse Oximeter
52S0P	NIBP / Nonin Pulse Oximeter / Printer
52N0P	NIBP / Nellcor Pulse Oximeter / Printer
52ST0	NIBP / Nonin Pulse Oximeter / Temperature
52NT0	NIBP / Nellcor Pulse Oximeter / Temperature
52STP	NIBP / Nonin Pulse Oximeter / Temperature / Printer

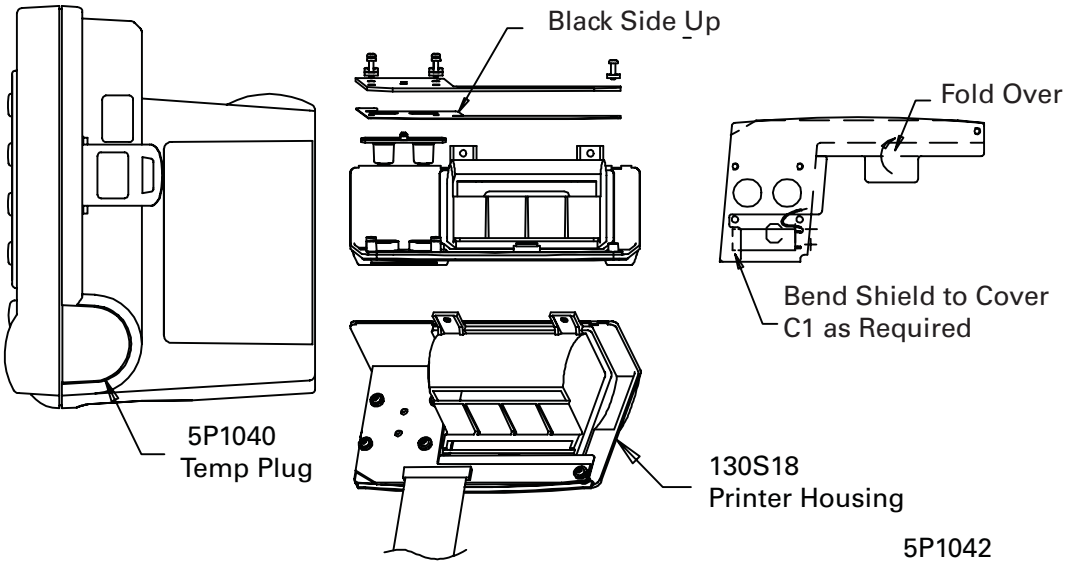
Accessories

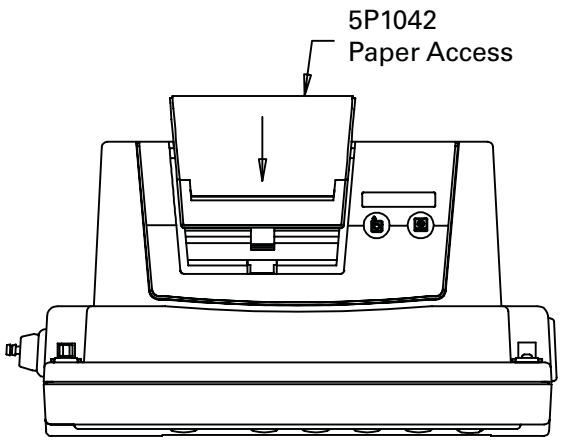
Part#	Blood Pressure Accessories
5200-01	Adult Cuff Assembly (cuff, latex-free bladder and connectors)
5200-02	Large Adult Cuff Assembly (cuff, latex-free bladder and connectors)
5200-03	Small Cuff Assembly (cuff, latex-free bladder and connectors)
5200-10	Extra-large Cuff Assembly (cuff, latex-free bladder and connectors)
5200-04	Adult Bladder (latex-free, includes connector)
5200-05	Large Adult Bladder (latex-free, includes connector)
5200-06	Small Bladder (latex-free, includes connector)
5200-11	Extra-large Adult Bladder (latex-free, includes connector)
5082-59	Adult Cuff
5082-61	Large Adult Cuff
5082-63	Small Cuff
5082-64	Extra-large Adult Cuff
5082-203-3	Small child size durable, one piece cuff (includes connectors)
5082-204-3	Child size durable, one piece cuff (includes connectors)
5082-205-3	Small adult size durable, one piece cuff (includes connectors)
5082-206-3	Adult size durable, one piece cuff (includes connectors)
5082-207-3	Large adult size durable, one piece cuff (includes connectors)
5082-208-3	Extra-large adult size durable, one piece cuff (includes connectors)

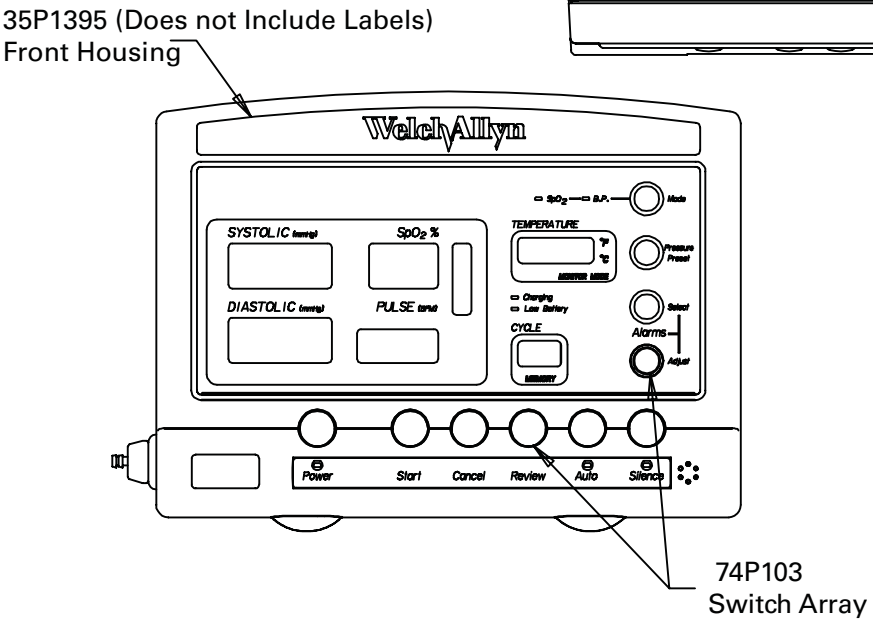
5082-93-3	Small child size disposable cuff (includes connectors) Box of 5 cuffs.
5082-94-3	Child size disposable cuff (includes connectors) Box of 5 cuffs.
5082-95-3	Small adult size disposable cuff (includes connectors) Box of 5 cuffs.
5082-96-3	Adult size disposable cuff (includes connectors) Box of 5 cuffs.
5082-97-3	Large adult size disposable cuff (includes connectors) Box of 5 cuffs.
5082-98-3	Extra-large adult size disposable cuff (includes connectors) Box of 5 cuffs.
5200-19	Straight Pressure Hose (5 feet, latex-free)
5200-12	Straight Pressure Hose (8 feet, latex-free)
5200-08	Calibration "T" Connector
	Thermometry Accessories
02678-100	Oral Temperature Probe
02679-100	Rectal Temperature Probe
05031-101	Disposable Probe Covers (1000, packaged 25 per box)
06137-000	Temperature Calibration Key
01800-210	Model 9600 Temperature Calibration Kit., 110v
	Nonin Pulse Oximetry Accessories
5200-40	Finger Clip Sensor (Adult) with 9 foot cable
5200-56	FingerClip Sensor (Pediatric) with 9 foot cable
5200-41	Ear Clip Sensor
5200-42	Flex Sensor
5200-44	Reflectance Sensor
5200-45	Reflectance Sensor Holder (box of 10)
5200-46	Adult Finger Flexiform Sensors (single use, box of 10)
5200-47	Pediatric Finger Flexiform Sensors (single use, box of 10)
5200-50	Sensor Attachment Tape
5200-51	Hydrogel Tape Strips
5200-52	Extension Cable (3 feet)
5200-54	Finger Clip Sensor with 3 foot cable
5200-55	Extension Cable (9 feet)
	Nellcor Puritan Bennett Pulse Oximetry Accessories
DS-100A	DURASENSOR Adult Oxygen Transducer
DEC-8	Extension Cable (8 feet)
D-YS	DURA-Y Oxygen Transducer (1 sensor, 40 wraps)
D-YSE	Ear Clip (use with Dura-Y sensor)
D-YSPD	PediCheck Pediatric Spot Check (use with Dura-Y sensor)
OXICLIQ P	Pediatric Oxygen Transducer, use with OC-3 cable
OC-3	OXICLIQ Sensor Cable

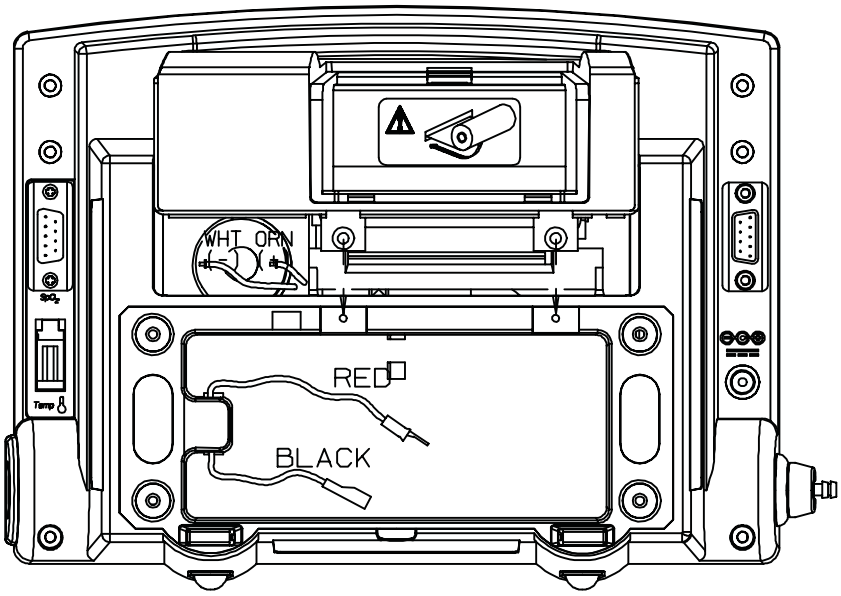
OXI - A/N	OXIBAND Adult/Neonatal Transducer (1 sensor, 50 wraps)
OXI - P/I	OXIBAND Pediatric/Infant Transducer (1 sensor, 50 wraps)
MAX-A	OxiMAX Adult (single use, case of 24)
MAX-I	OxiMAX Infant (single use, case of 24)
MAX-P	OxiMAX Pediatric (single use, case of 24)
MAX-R	OxiMAX Nasal (single use, case of 24)
SRC-2	Portable Oximetry Tester (non-motion tolerant SPO_2 only)
SRC-MAX	Portable Oximetry Tester (motion tolerant SPO_2 only)
	Mounting Accessories
5200-60	Mobile Stand with Accessory Pack
5200-61	Mobile Stand without Accessory Pack
5200-62	Wall Mount with Accessory Pack
5200-63	Wall Mount without Accessory Pack
5200-64	IV Pole Mount with Accessory Pack
5200-65	IV Pole Mount without Accessory Pack
5200-66	Bedrail Mounts with Accessory Pack
5200-67	Bedrail Mounts without Accessory Pack
5200-68	Cuff Clip
5200-69	Accessory Pack
5200-70	Anti-Theft Kit for Mounting Devices
5200-106	Transformer Mounting Kit (use w/ desktop transformer only)
	Power Transformer Accessories
5200-101A	AC Power Transformer (desktop version) North American
76400	Line Cord (US / Canada / Japan version)
	Miscellaneous Accessory Items
7052-25	Printer Paper (box of 6 rolls)
5200-84	Lead-Acid Battery (6 volt, rechargeable)
5200-85E	Operator Manual (English version)
5200-145E	Technical Service Manual
5200-100	Monitor Carrying Case
5200-170	Connectivity Tool Kit

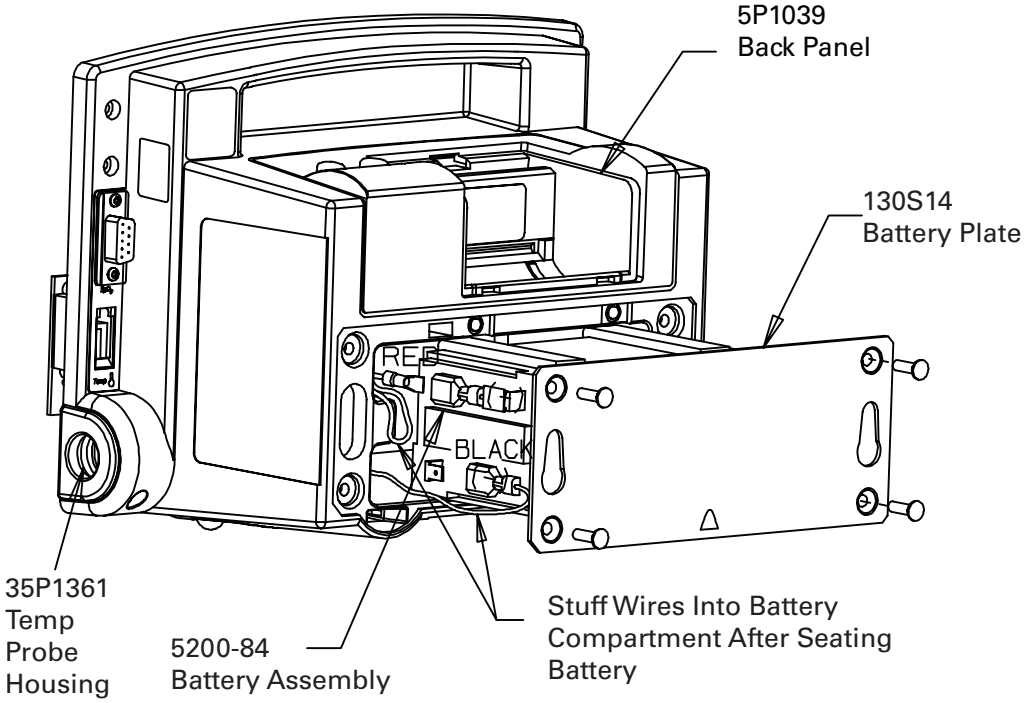

130S53
Temperature
Connector Board
For 678
TO X1
TO XD1
130S52
Temperature
PCB
130S4
Display
PCB
74P103
Switch Array

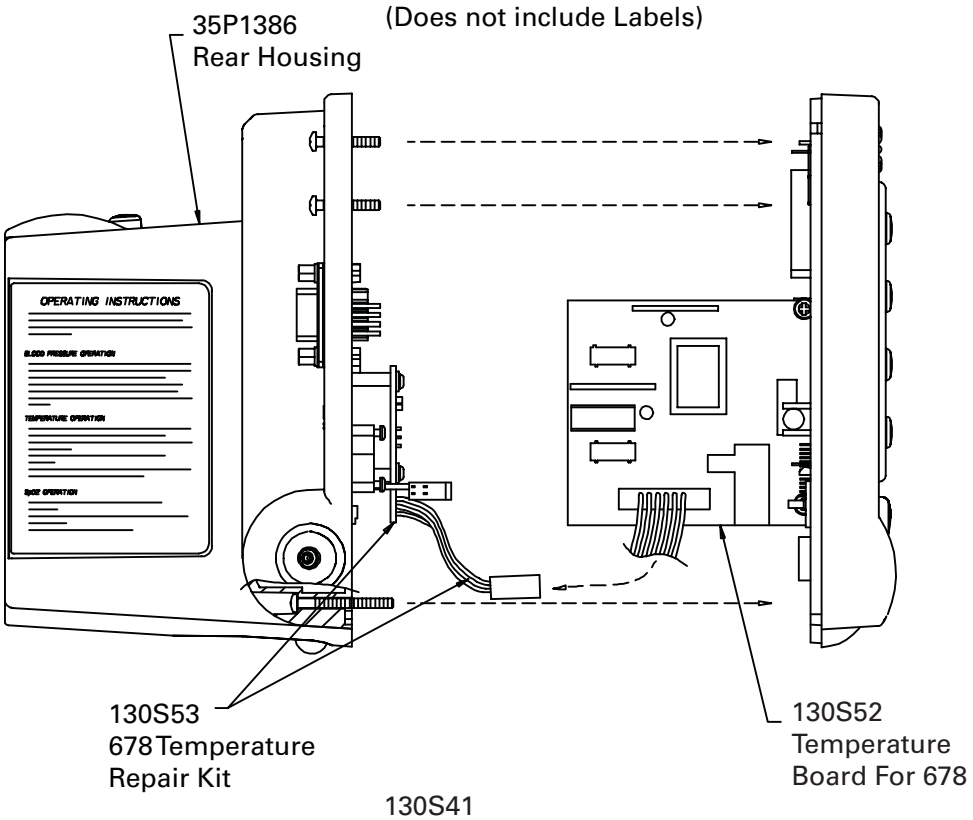

Black Side Up
Fold Over
Bend Shield to Cover
C1 as Required
5P1040
Temp Plug
130S18
Printer Housing

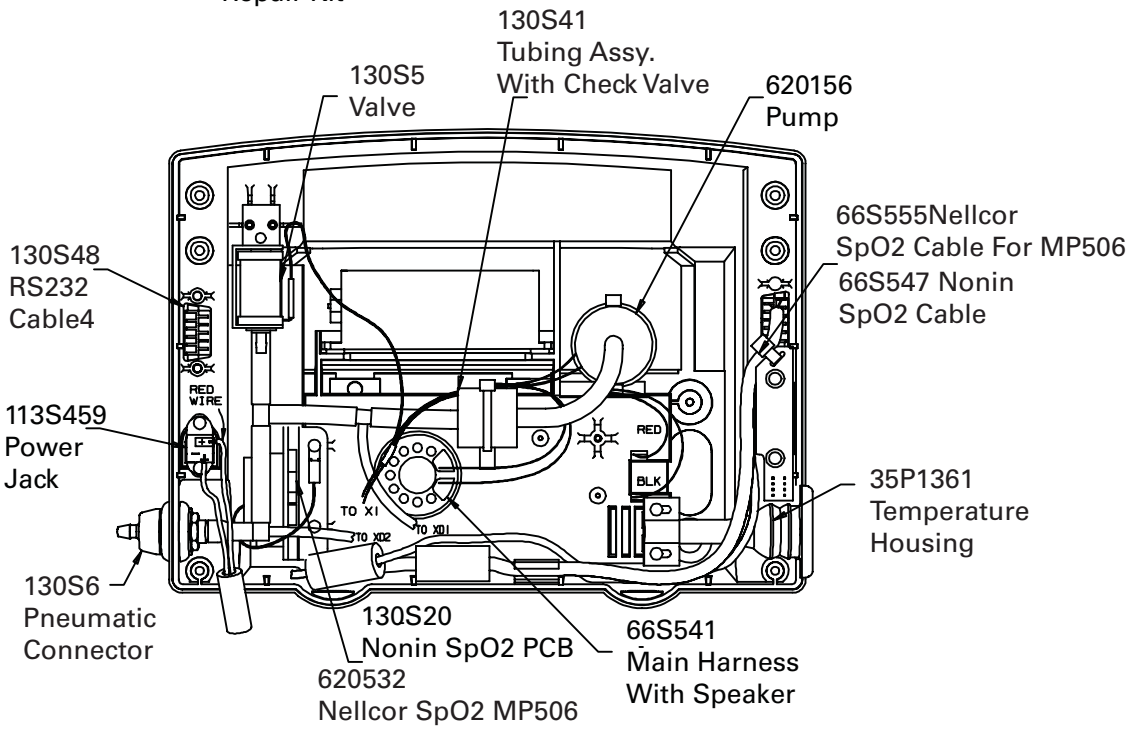

5P1042
Paper Access

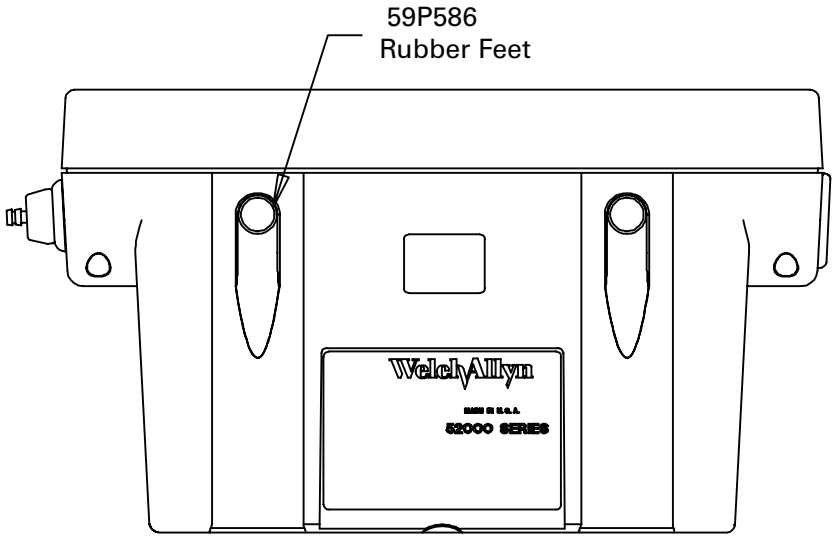

35P1395 (Does not Include Labels)
Front Housing
Welch Allyn
SYSTOLIC
DIASTOLIC
PULSE
TEMPERATURE
CYCLE
Alarms
Power
Start
Cancel
Review
Auto
Silence
74P103
Switch Array

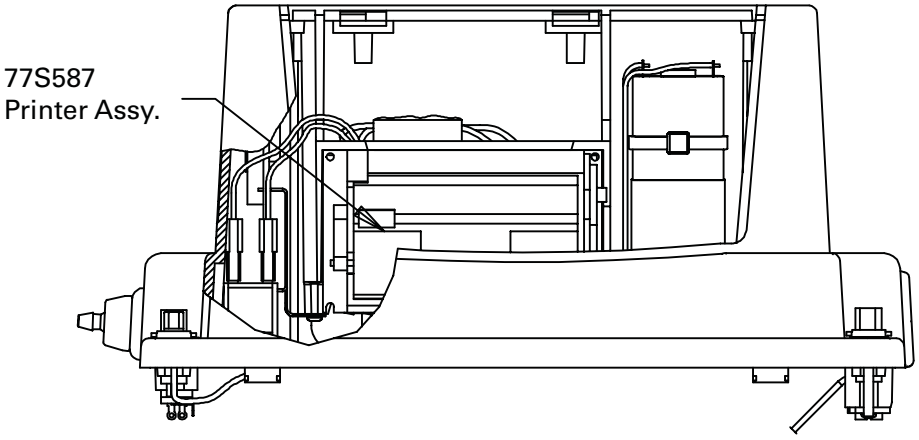

WHT ORN
RED
BLACK

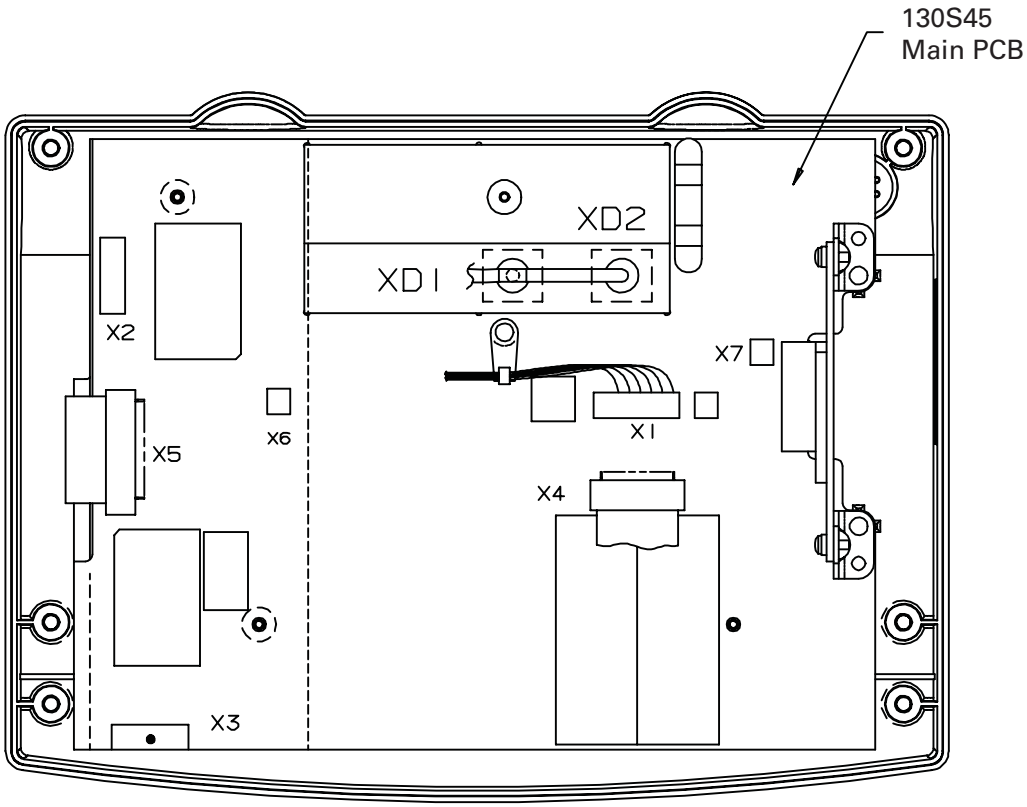

5P1039
Back Panel
130S14
Battery Plate
RED
BLACK
35P1361
Temp
Probe
Housing
5200-84
Battery Assembly
Stuff Wires Into Battery
Compartment After Seating
Battery

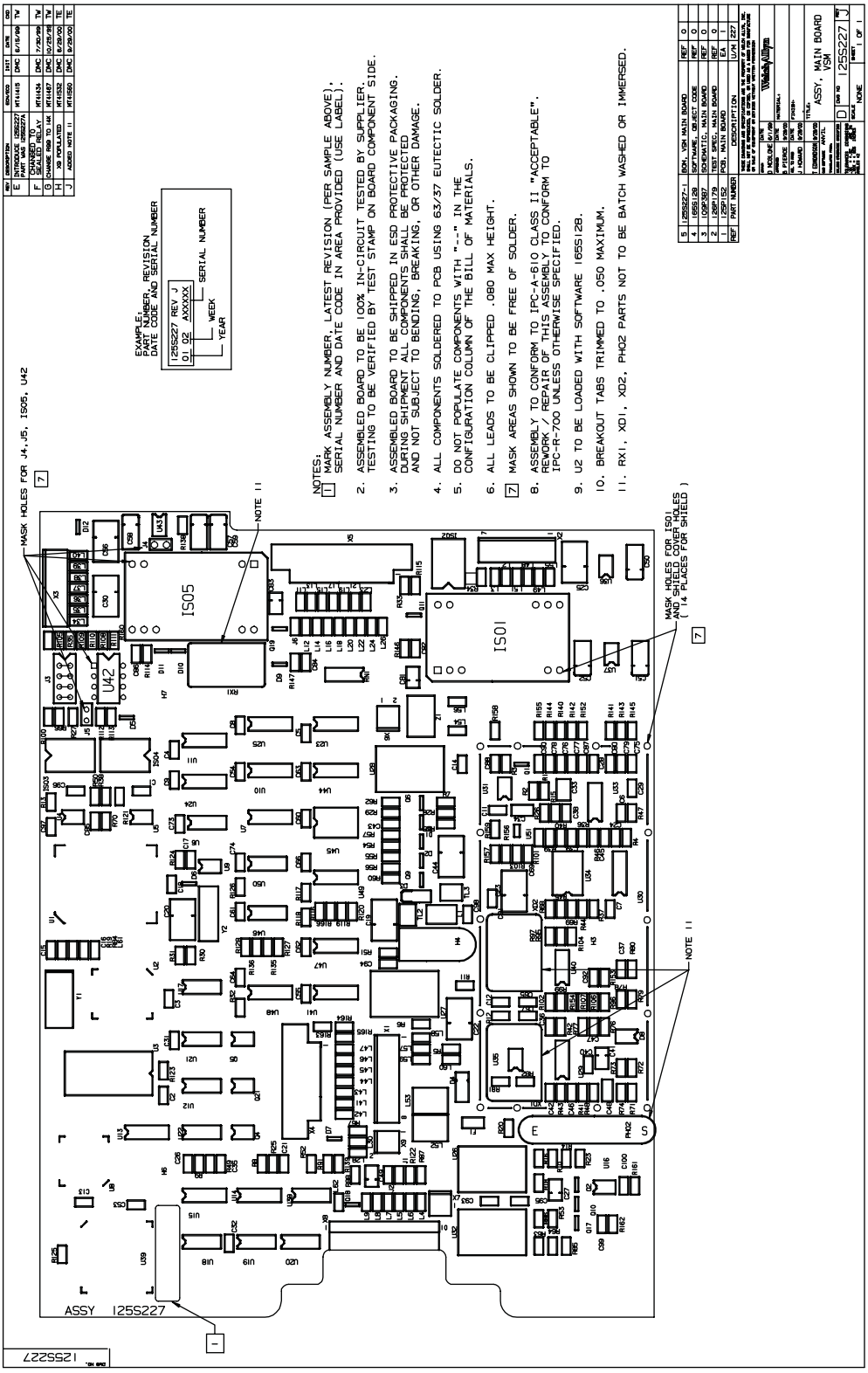

35P1386
Rear Housing
(Does not include Labels)
OPERATING INSTRUCTIONS
130S53
678 Temperature
Repair Kit
130S52
Temperature
Board For 678


130S41
Tubing Assy.
With Check Valve
130S5
Valve
620156
Pump
66S555Nellcor
SpO2 Cable For MP506
66S547 Nonin
SpO2 Cable
130S48
RS232
Cable4
113S459
Power
Jack
35P1361
Temperature
Housing
130S6
Pneumatic
Connector
130S20
Nonin SpO2 PCB
620532
Nellcor SpO2 MP506
66S541
Main Harness
With Speaker
RED
WIRE
RED
BLK
TO X1
TO X2
TO X01


59P586
Rubber Feet
Welch Allyn
52000 SERIES


77S587
Printer Assy.


130S45
Main PCB
XD2
XD1
X2
X7
X6
X1
X5
X4
X3


NOTES:
1. MARK ASSEMBLY NUMBER, LATEST REVISION (PER SAMPLE ABOVE), SERIAL NUMBER AND DATE CODE IN AREA PROVIDED (USE LABEL).
2. ASSEMBLED BOARD TO BE 100% IN-CIRCUIT TESTED BY SUPPLIER. TESTING TO BE VERIFIED BY TEST STAMP ON BOARD COMPONENT SIDE.
3. ASSEMBLED BOARD TO BE SHIPPED IN ESD PROTECTIVE PACKAGING. DURING SHIPMENT ALL COMPONENTS SHALL BE PROTECTED AND NOT SUBJECT TO BENDING, BREAKING, OR OTHER DAMAGE.
4. ALL COMPONENTS SOLDERED TO PCB USING 63/37 EUTECTIC SOLDER.
5. DO NOT POPULATE COMPONENTS WITH "--" IN THE CONFIGURATION COLUMN OF THE BILL OF MATERIALS.
6. ALL LEADS TO BE CLIPPED .080 MAX HEIGHT.
7. MASK AREAS SHOWN TO BE FREE OF SOLDER.
8. ASSEMBLY TO CONFORM TO IPC-A-610 CLASS II "ACCEPTABLE". REWORK / REPAIR OF THIS ASSEMBLY TO CONFORM TO IPC-R-700 UNLESS OTHERWISE SPECIFIED.
9. U2 TO BE LOADED WITH SOFTWARE 1665128.
10. BREAKOUT TABS TRIMMED TO .050 MAXIMUM.
11. RX1, XD1, XD2, PH02 PARTS NOT TO BE BATCH WASHED OR IMMERSED.
EXAMPLE:
PART NUMBER, REVISION
DATE CODE AND SERIAL NUMBER
1255227 REV J
01 02 AXXXXX
SERIAL NUMBER
WEEK
YEAR
MASK HOLES FOR J4, J5, ISO5, U42
NOTE 11
MASK HOLES FOR ISO1 AND SHIELD COVER HOLES (14 PLACES FOR SHIELD)
ASSY 1255227
ASSY, MAIN BOARD VSM
1255227

Repair Test Specifications

Note 1: *The word "Unit" throughout this document refers to the second generation VSM unit with out pneumatics (tubing and cuff), temperature probe, SpO_2 probe, and main battery attached, unless other wise noted.*

Note 2: *All tests are performed in the "Detailed Test Mode" or in the "Normal Mode" unless otherwise noted.*

Note 3: *Standard test voltage unless otherwise stated is 6.5 Vdc (±0.25 Vdc).*

Note 4: *All tests are performed utilizing the Repair Software for the second generation VSM.*

Note 5: *Unless otherwise stated, all calibrated volumes will be ±10 cc of the stated volume.*

Note 6: *Unit software for the second generation VSM will be equal to or greater than "5.0" If the unit has Nonin SpO_2, the Nonin SpO_2 software will be equal to or greater than "7." If the unit has Nellcor MP205 SpO_2, the Nellcor SpO_2 will be equal to or greater than "1.2.0.0." If the unit has Nellcor MP506 SpO_2, the Nellcor SpO_2 will be equal to or greater than "1.7.2.0". If the unit has the temperature option, the temperature software will be equal to or greater than "2.1".*

REPAIR TESTS

Leak Tests

1. The unit must not leak more than 5 mmHg in a 15 second interval while attache to a 100 cc calibrated cylinder and pressurized to between 245 and 255 mmHg.

2. The unit must not leak more than 5 mmHg in a 15 second interval while attached to a 100 cc calibrated cylinder and pressurized to between 45 and 55 mmHg.

Inflation Test

3. The unit must be able to inflate a 250.0 cc (+ 50.0 cc/- 0 cc) calibrated cylinder from less than 5.0 mmHg to greater than 210.0 mmHg in 7.0 seconds or less.

Dump Test

4. The unit must be able to deflate a 500.0 cc (+ 100.0 cc/- 0 cc) calibrated cylinder from greater than 260.0 mmHg to less than 15.0 mmHg in 10 seconds or less.

Unit Manometer Calibration

Note: *Internal temperature of the unit must be less than 89.9 °F (32 °C) before performing calibration. Prior to calibration the zero and gain pot must be set to 128. Prior to calibration the three pressure correction values must be set to 16384. Prior to calibration the safety zero offset value must be set to 0 and the safety gain must be set to 10000.*

5. The zero pot will be adjusted to produce a minimum error (±1 count) when 0 ±1 mmHg is applied. The count written to the pot must be between 5 and 250. The unit must successfully perform an auto-zero after this zero pot adjustment. The unit gain will then be calibrated for minimum error value (±1 mmHg) when a pressure between 195 mmHg and 205 mmHg is applied.

The unit's first pressure correction value will then be adjusted at a pressure between 90 and 100 mmHg to within ±1 mmHg of the applied pressure. The unit's second pressure correction value will then be adjusted at a pressure between 190 mmHg and 200 mmHg to within ±mmHg of the applied pressure. The unit's third pressure correction value will then be adjusted at a pressure between 280 mmHg and 290 mmHg to within ±1 mmHg of the applied pressure. The Pressure Correction Values written to the unit must be 16384 ±1000. Calibration information stored in the unit to includes the above constants, calibration date and time (local standard date and time), and a four character calibrator's identification signature (the calibrator's three initials and a "*". The "*" will be automatically placed into the signature by the VSM repair software).

6. The optimum safety zero offset will be adjusted to measure less than ±1.0 mmHg when 0.0 mmHg is applied to the unit. The optimum safety gain value will be adjusted to measure ±8.0 mmHg when 285 mmHg (±10 mmHg) is applied to the unit. The final safety zero offset must be between ±31767. The final safety gain value must be between +1000 and +31767.

Manometer Accuracy Test

7. Internal temperature of the unit must be less than 89.9 °F(32.0 °C) before performing test.

A. The primary transducer must be within ±0.75 mmHg at 0 ±0.3 mmHg. The safety transducer must be within ±1 mmHg at 0 ±0.3 mmHg.

B. The primary transducer must be within ±1.5 mmHg at 50 ±5.0 mmHg. The safety transducer must be within ±1.5 mmHg at 50 ±5.0 mmHg.

C. The primary transducer must be within ±1.5 mmHg at 150 ±5.0 mmHg. The safety transducer must be within ±4.5 mmHg at 150 ±5.0 mmHg.

D. The primary transducer must be within ±1.5 mmHg at 250 ±5.0 mmHg. The safety transducer must be within ±7.5 mmHg at 250 ±5.0 mmHg.

Deflation Test

8. With the unit connected to a large adult cuff and a target inflation pressure of 200 mmHg, have the unit perform a complete "normal" BP cycle. Steps 0 and 1 are dummy steps = 0.0 mmHg and are ignored. For steps two and three, the size of the step must be between 3.0 mmHg and 11.0 mmHg. Step 4 and all other steps above or equal to 40 mmHg, step size must be between 7.0 mmHg and 11.0 mmHg. All steps below 40 mmHg, except for the last step, will be between 4.5 mmHg and 10 mmHg. The last step will be between 0.01 mmHg and 10 mmHg.

Voltage Testing

9. The unit battery voltage reading must be calibrated to within ± 0.05 Vdc at a nominal calibrated battery voltage input of 5.6 Vdc (+0.3 / -0.0 Vdc). Calibration should include a verification test at this specified test point. A four character calibration signature is written to the unit upon satisfactory calibration completion (the calibrator's three initials and a "*". The "*" will be automatically placed into the signature by the VSM II repair software).

Unit Current Tests

Note: *The current levels called out below will be 40 mA higher in units that are configured with Acuity communication hardware and software.*

10. Unit "Blank" mode current must less than or equal to 80.0 mA. "Blank" mode current is determined when all LED segments are off, SpO_2 mode is off, and the Temperature board is asleep.

11. Unit "Idle" mode current must be less than or equal to 800 mA. "Idle" mode current is determined when all LED segments are on, SpO_2 mode is off and the Temperature board is asleep.

12. Unit "Pump" mode current must be less than or equal to 600 mA. "Pump" mode current is determined by putting the unit into "Blank" mode, actuating the valve on, operating the pump on. Record the current.

Noise Test

13. Internal electrical noise of the unit's pressure channel, determined by using serial 1 second noise sample command, must be less than or equal to 0.05 mmHg.

Hardware Fail-safe Tests

Over pressure test:
14. Units hardware must detect over pressure on unit pneumatic system between 296.0 mmHg and 329.0 mmHg.

Note: *Over 15 mmHg and under 15 mmHg tests are disabled in the VSM2 Monitor.*

Over 15 mmHg Test:
15. Unit hardware must detect if the pneumatic system has been pressurized greater than 15 mmHg for more than 155 second but less than 180 seconds.

Under 15 mmHg Test:
16. Unit hardware must detect if the pneumatic system has been pressurized less than 15 mmHg for more than 25.0 seconds but less than 35.0 seconds before allowing new inflation cycle in "non-STAT" AUTO mode.

SpO_2 Tests

SpO_2 Option Testing (Nonin):
Note: *Settings for this test are specific to the "Nonin Patient Simulator" model 8000S.*

17. Accuracy of the SpO_2 board, after a 25 second stabilization period, must be within ±2% O_2 and ±2 BPM. Values are 98% O_2 and 80 BPM.

18. Unit "SpO_2" mode current must be less than or equal to 80.0 mA. "SpO_2" mode current is determined by turning off all the LEDs, putting the Temperature board asleep, actuating the SpO_2 and waiting 25 second for stabilization. Recorde the current, then subtract "Blank" mode current from the test current.

SpO_2 Option Testing (Nellcor MP205):
Note: *Settings for this test are specific to the "Nellcor Patient Simulator" model SRC2.*
19. Accuracy of the Nellcor SpO_2 board after a 25 second stabilization period, must be within ±2% O_2 and ±2 BPM. Values are 81% O_2 and 112 BPM.

20. Unit "SpO_2" mode current must be less than or equal to 120 mA. "SpO_2" mode current is determined by turning off all LEDs, putting the temperature board asleep, Actuating the SpO_2 and waiting 25 seconds for stabilization. Record the current, then subtract "Blank" mode current from the test current.

SpO_2 Option Testing (Nellcor MP506):
Note: *Settings for this test are specific to the "Nellcor Patient Simulator" model SRCMAX2.*
21. Accuracy of the Nellcor SpO_2 board, after a 25 second stabilization period, must be within ±2% O_2 and ±2 BPM. Values are 75 or 90% O_2 and 60 or 200 BPM.

22. Unit "SpO_2" mode current must be less than or equal to 120 mA. "SpO_2" mode current is determined by turning off all LEDs, putting the temperature board asleep, actuating the SpO_2 and waiting 25 seconds for stabilization. Record the current, then subtract "Blank" mode current from the test current.

Temperature Option Testing

23. The accuracy of the Temperature board must be within ±0.2 °F for readings with a nominal temperature of 97.3 °F (36.3 °C) (Using the CAL Key).

24. The unit must be able to read a temperature of 96.4 °F (35.8 °C) and a temperature of 106 °F (41.1 °C) within ±0.3 °F (±0.2 °C) using the Welch Allyn 9600 Calibrator to obtain temperatures.

Note: *If using a water bath to take temperature reading, the temperature of the bath should be between 84 and 106 °F (28.8 and 41.1 °C) and the reading must be within ±1.0 °F (0.8 °C) measure against a temperature standard that is accurate to ±1 °F (0.8 °C).*

25. Unit “Temperature” mode current must be less than or equal to 15.0 mA. "Temperature" mode current is determined by turning off all LEDs, turning SpO_2 mode off and by actuating the temperature board. Wait 5 seconds for reading. Record the current reading and then subtracting "Blank" mode current from test current.

Printer Option Testing

26. The printer must be able to print out test pattern 1 and test pattern 2 (small and large ASCII characters (test 1) gray solid field (test 2). The technician will subjectively determine if the print quality is sufficient.

RS232 Testing

27. The RS232 communication operation will be confirmed with successful serial transmit and receive.

RS423 Testing (Acuity Monitors)

28. The RS423 communication operation will be confirmed with successful serial transmit and receive, at 19.2 K Baud.

Failure

Basic Information

Date/Time:	
Observed by:	
Model Number:	
S/N:	
Unit SW Ver.:	
Life Cycle Count:	
Repair # (cust. returns)	

Test Failed / Reason for Return

- ☐ Error Code:
- ☐ LEDs
- ☐ Buttons
- ☐ Alarm
- ☐ Won't Power Up/Down
- ☐ BP, Won't Calibrate
- ☐ BP, Readings Too High
- ☐ BP, Other Problem
- ☐ Temp Problem
- ☐ SpO_2 Problem
- ☐ Printer Problem
- ☐ Other. . .

Description:

Repair

Basic Infomation

Date/Time:	
Repaired by:	

Primarily, the Following Component (if any) Was Involved in the Failure:

☐ Main Board	☐ SpO_2 Main Cable	☐ Buttons	☐ Other Components
☐ Display Board	☐ SpO_2 to Sensor Cable	☐ Check Valve	☐ Not Applicable
☐ $Sp0_2$ Board	☐ Display Cable	☐ Battery	
☐ Temp Board	☐ Printer Cable	☐ Pneumatic Assembly	
☐ Temp Connector Board	☐ Charger cable	☐ Speaker	
☐ Printer Board	☐ Valve	☐ Temp probe	☐ Temp Cable
☐ Main Cable	☐ Pump	☐ SpO_2 Sensor	☐ Transformer
☐ Serial cable	☐ Printer		☐ Pressure Switch

If a component(s) is replaced, indicate below:

Description:	PN	SN out	SN in

Test Information	Unit Readings	Acceptable Ranges
Unit Software Version		> 5.0
Temperature SW Version		>= 2.1
SpO_2 SW Verison		Nonin > 7 Nellcor MP205 >= 1.2.0.0 Nellcor MP506 >= 1.7.2.0
Test Pressure (0 mmHg)		-0.3 to 0.3 mmHg
Primary Pressure (0 mmHg)		-0.75 to 0.75 mmHg
Safety Pressure (0 mmHg)		±1 mmHg
Test Pressure (250 mmHg)		245 to 255 mmHg
Primary Pressure (250 mmHg)		±1.5 mmHg
Safety Pressure (250 mmHg)		±7.5 mmHg
Test Pressure (150 mmHg)		145 to 155 mmHg
Primary Pressure (150 mmHg)		±1.5 mmHg
Safety Pressure (150 mmHg)		±4.5 mmHg
Test Pressure (50 mmHg)		45 to 55 mmHg
Primary Pressure (50 mmHg)		± 1.5 mmHg
Safety Pressure (50 mmHg)		±1.5 mmHg
Unit Battery Calibration Test Voltage 5.6 Vdc		5.6 Vdc (+0.3 Vdc / -0.0 Vdc)
Battery Calibration Voltage Reading "Voltage Reading from above"		±0.05 Vdc
Blank Mode Current		<= 80 mA
Idle Mode Current		<= 800 mA
Pump Current		<= 600 mA
SpO_2 Current		Nonin <= 80 mA Nellcor MP205 <= 120 mA Nellcor MP506 <= 120 mA
Temperature Current		<= 15 mA
Noise Level		<= 0.05 mmHg
Button Test		Pass/Fail
Print Quality		Pass/Fail
Unit Leak @ 250 mmHg		<= 5 mmHg in 15 sec.
Unit Leak @ 50 mmHg		<= 5 mmHg in 15 sec.
Inflation Time		<= 7 sec.
Dump Time		<= 10 sec.
Deflation Test		Pass/Fail
Over Pressure Test		296 to 330 mmHg
Over 15 mmHg		Pass/Fail
Residual Pressure Test		Pass/Fail
SpO_2 Simulator Reading		Nonin – 98% 80 BPM Nellcor MP205 81% 112 BPM Nellcor MP506 75% or 90% 60 or 200 BPM
SpO_2 Sensor Reading		Pass/Fail
Temperature Cal Key Reading		97.3 °F ±0.2°F (36.3°C ±0.1°C)
Temperature Cal Reading (96.4°F)		96.4° F ±0.3°F (35.8 °C ±0.2 °C)
Temperature Cal Reading (106°F)		106°F ±0.3°F (41°C ±0.2°C)
Nurse Call test		____Pass ____ Fail